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RetroSonic Music Player

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Abstract

The RetroSonic Music Player project aims to develop a standalone JavaFX application that combines music playback with direct metadata editing capabilities. This application addresses a gap in existing media players by integrating detailed management of MP3 metadata with standard music player functionalities, thereby catering to users who seek a more involved interaction with their digital music libraries. The application supports playback controls, playlist management, and metadata editing, for song tags such as title, artist, album and year.

Unlike conventional music players that separate media consumption from media management, RetroSonic integrates these aspects into a single, intuitive interface, allowing users to not only upload & play music but also modify song metadata permanently without the need for external software. The project leverages JavaFX for its graphical user interface and the MP3agic library to handle metadata manipulation, providing a robust platform for both novice and experienced users.

The design of RetroSonic emphasises simplicity and user-friendliness, featuring a Simplified User Interface (SUI) that makes navigation and operation accessible to all users, regardless of their technical proficiency.

Throughout its development, the project underwent rigorous bug-fixing to ensure functionality and usability. The final product is a versatile tool that enhances users' interaction with their music collections, offering a personalised listening experience. The RetroSonic Music Player project sets the foundation for a new type of music player that empowers users to manage their music libraries in a more detailed and integrated manner.

Statement of Ethical Compliance

Data Categories: A

Participant Category: 3

I have complied with the ethical guidance standards of this module. Participants for the Survey gave confirmation that they were okay with their results being used for this dissertation. The IP address retrieval feature of SurveyMonkey was disabled & users did not input names so the results are anonymous. Check appendix A1 for information about the survey.

Table of Contents & Figures

7. BCS Criteria & Self Reflection
8. References
9. Appendix

1 - Introduction & Background

MP3 files, due to their compact size and decent quality, have become one of the most popular audio formats[***1***]. However, efficiently managing and editing the metadata of these files can be challenging, especially for users looking to personalise their music libraries.

This project focuses on developing a JavaFX application designed to use, edit and manage the metadata of MP3 files all within one environment where songs can be played or added to playlists like iTunes. The difference between RetroSonic and a music player like iTunes is not only the metadata reading and writing functionality but also the Simplified User Interface (SUI) which is implemented to allow for easy navigation within the application even for users who are less technologically adept[***2***]. RetroSonic focuses on providing a streamlined, focused experience specifically for just playing music and managing and editing MP3 metadata so the song formats properly in your music libraries.

JavaFX is a software platform for creating and delivering rich desktop applications[***3***]. It was intended to replace Swing as the standard GUI library for Java[***4***]. JavaFX provides a powerful Java-based UI platform which allows for applications to be built for Cross-Platform uses across Linux, Windows and MacOs[***5***]; consequently allowing RetroSonic to achieve the first aim in section ***2.1*** of being cross-platform. Another powerful component used in this project is the JavaFX MediaPlayer, which allows for the handling of audio files and playback controls such as play/pause, and next/previous buttons[***6***]. This helps us achieve aim 7 of providing play, next & previous buttons in section ***2.1***. The extensive API allows for a lot of future extensions with features like an equaliser for frequency adjustment[***7***] and video playback functionality.

FXML Graphical User Interface Markup Language is an XML-based language created by Oracle for defining the user interface (UI) of a JavaFX application. Using FXML to design the UI of JavaFX applications allows developers to separate the presentation layer from the logic layer, improving code readability and maintainability[***8***]. This separation follows the Model-View-Controller (MVC) design pattern which was taught in ***COMP319-Software Engineering 2*** enabling more efficient code reuse and parallel development. These FXML files can be edited within Scenebuilder.

Scenebuilder is a powerful tool that greatly simplifies the development of JavaFX applications[***9***], particularly when aiming to create a Simplified User Interface (SUI). The design of an SUI focuses on ease of use, minimalism, and efficiency, ensuring that users can navigate and utilise the application without unnecessary complexity[***10***]. Scene Builder provides a What You See Is What You Get (WYSIWYG) environment, enabling developers to design the UI visually[***11***]. Scene Builder supports the application of CSS styles to JavaFX components which is useful for parts which are hard to design visually. With Scene Builder, prototypes of the user interface can be quickly developed, which was the case with RetroSonic, where the prototype of the project was designed for the proposal, and then ended up being used as the base to start developing the front end which can be seen in Chapter ***3.1.1***.

MP3agic is a powerful, open-source Java library that reads and manipulates the metadata and MP3 file information. MP3agic allows the application to read various metadata values from MP3 files, such as title, artist, album and year. This capability is essential for organising and displaying songs in your music player in a user-friendly manner. A key feature of RetroSonic is allowing users to edit the metadata of their MP3 files. MP3agic provides the functionality to modify tags, enabling your application to update information like song titles, artists, and albums directly within the user interface[***12***]. Metadata extracted using MP3agic can be bound to JavaFX UI components, ensuring that any changes in the metadata are immediately reflected in the user interface.

2 - Requirements Analysis

2.1 - Project Aims

The Aims of this Music Player were:

1. To be Cross Platform;
2. Implement a Simplified User Interface(SUI);

3. Be able to upload music files;
4. All music is displayed in the library;
5. Music with no tags provided default values;
6. Tags can be edited through the application;
7. Songs can be played, next & previous;
8. Show the frequently played songs;
9. The Music player can be used across every scene with only one instance being created;
10. Songs can be added and removed from playlists;

Another important requirement is persistence when holding data particularly with the Frequently Played Songs and Playlists. When the user closes the application, this data should be saved for when the user reopens the application. This persistence is done through serialisation which is discussed thoroughly in Section ***3.2*** of the Back-End.

2.2 - Survey Insights

A survey (done on SurveyMonkey) was taken to find what people require within a music player before the initial proposal of the project.

The people who took the survey were informed and agreed for their results to be used in this dissertation. Their answers from the survey were anonymous.

These are a few of the responses to the questions asked: **Q1; What are some features you would expect in a music player?** & **Q2; What are some extra features you would love to see in a music player app?**

Q1: What are some features you would exp...	Q2: What are some extra features you wou...
Playlists, Shuffling, Queue, Search, Liked songs	Ratings, Suggested songs/albums/artists, Genr
Making playlists, downloading playlists, being a	different types of shuffle in a playlist, and algo
The ability to make multiple playlists	Recommend songs I would possibly like based
Custom playlists, song info like artists genre ye	Can't think of anything Spotify doesn't already
Pause/ play button, skip / rewind button, creati	Be able to download songs as mp3 files to PC,
Ability to create playlists	Share music with other "friends" or other app
Easy to navigate home page	Extra social interaction, able to share songs ea
Features that allow me to download music so th	Features that make it easy for me to find new s
Background play whilst using other apps	
Music to be ordered appropriately, layout make	Suggestions of music I might like based of the
Playlists, Albums, Charts	Customisation

Figure 1: Survey Taken for the Project Requirements

Some common requirements taken from *Figure 1* were:

- Play/Pause, Rewind, Shuffle and Loop buttons
- a function to upload music to a library
- an ability to edit attributes of songs(photo, name, artist or year)
- a function to create playlists and manipulate them (change order, add/remove songs)
- the ability to function offline
- the ability to function on Windows, MacOs and Linux
- Playlists show the length of the playlist and how many songs are within the playlist.

- Recommend songs to users (offline music player - so cannot recommend songs that haven't been uploaded, however, frequently played songs are recommended to users as an alternative.)

3 - Design & Implementation

3.1 - Front - End

At the beginning of the project, the Front-End was prioritized resulting in establishing a solid and intuitive Front-End before delving into the Back-End logic[***3.2***]. The rationality behind this was that each element in the user interface was assigned a unique FX:ID, which is a specific identifier used in JavaFX to link the graphical components on the Front-End with their corresponding logic in the back-end code.

The project started by initiating the Front-End design directly within SceneBuilder[***3.1.1***], which proved to be a highly effective strategy as it made it simpler to build upon the original design[***Figure 2***] by adding components such as buttons and labels[***3.1.2***]. Once this was complete the respective FX:IDs of the components were linked to the back-end which will be discussed in Chapter ***3.2***. Once the Back-End was completed, the Front-End had some slight visual adjustments to ensure the symmetry of components which resulted in the finished product [***3.1.3***].

3.1.1 - Initial Design of the Front-End

3.1.1.1 - Main.FXML

The initial prototype design for the music player dashboard built on SceneBuilder is displayed in ***Figure 2***:

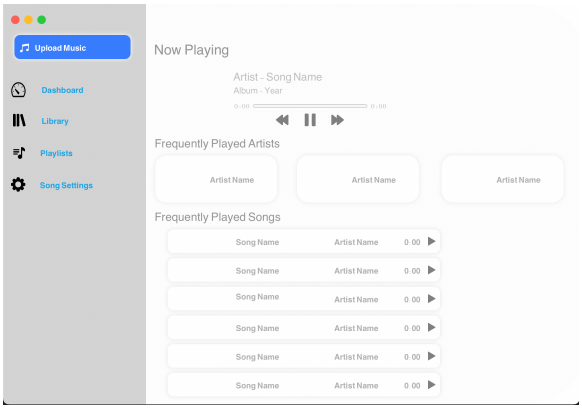


Figure 2: Initial Prototype Design made for the Project Proposal

The scene is built with a BorderPane, which splits the UI into five parts (Top, Bottom, Left, Right & Middle), however, in this project, it only uses two (Left & Middle). In these two parts, a pane is inserted so that components can be placed on top.

The Left Pane contains our Sidebar. This is where we implement our buttons (Upload, Dashboard, Library, Playlists & Settings). In ***Figure 2***, these are only labels but they are later converted into buttons in Section ***3.1.2***.

In the Middle Pane, for the dashboard design, a few labels representing the song details along with, Play, Next, and Previous images for media playback have been implemented. Then we also have HBoxs(Horizontal Boxes) confined within a VBox(Vertical Box) to represent Frequently Played Songs/Artists (The Artist feature was removed by the end of the process, it is discussed why in Section ***3.1.2***). This VBox containing eight HBoxs can be populated with frequently played song values which will be shown in Chapter ***3.2.6.4a***.

VBoxs allow for components to be placed vertically and Hboxs allow for components to be placed horizontally[***13***]. In this case, the VBox places 8 Hboxs within it vertically. These HBoxes hold 5 components horizontally: the song art(which was removed for efficiency), the song name, the artist name, the song length and the play button.

There are blank spaces in ***Figure 3*** next to the songs and artist name, in actuality, these are not blank and contain an "ImageView" container which displays the Song Art:

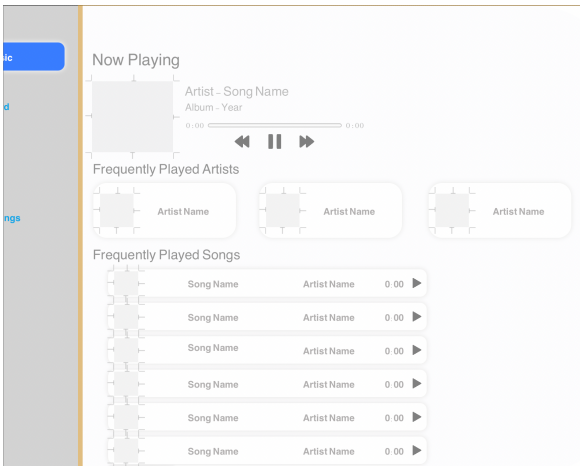


Figure 3: ImageView containers within the application

The Song Art is extracted from the Song's metadata or provided as a default image from the Song Class in Section ***3.2.4***. This default image matches the same blue undertones as the Upload Music button. The main premise behind this was to keep things simple to abide by a Simplified User Interface[***10***] while using a bright blue colour to make certain components stand out such as the upload music button. The aim was for the user to be able to navigate the app by following the blue colour subconsciously, as it guides the user through the app.

By the end of the design stage of this prototype dashboard, the features to implement in the Back-End became apparent and clearer:

- An "Upload Music" button action;
- Default values for the Music (Image, Title, Artist, Album, Year);
- Music playback actions(Next/Previous, Pause/Play);
- Algorithm to calculate and populate the Frequently Played Songs/Artists;
- Function to switch between dashboard, library & playlists (Scenes);
- A means for the music player to keep a single song instance while switching between scenes.

3.1.2 - Implementing Components for the Front-End

To get from the prototype in Chapter ***3.1.1***[***Figure 2***] to the finished front end[***3.1.3***], a couple of iterative changes were made:

First of all, in ***Figure 4***, all the labels in the sidebar were turned into buttons:

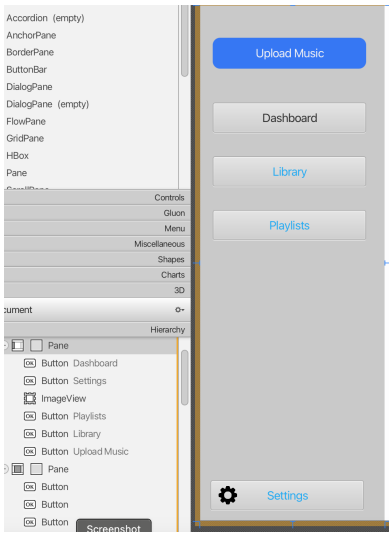


Figure 4: Implementation of Buttons for switching the Scene

The Upload Music & Settings buttons in ***Figure 4*** contain methods used for specific features like uploading MP3s or editing metadata.

These buttons are all linked to methods in the back end, by selecting the button and then changing the "*On Action*" method, as seen in ***Figure 5***:

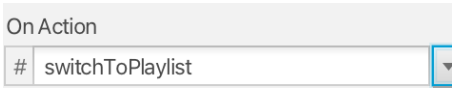


Figure 5: Method placed within the buttons in Figure 4, method name varies slightly for each button

The Dashboard, Library, and Playlists are important especially as they contain methods that will allow them to switch between each scene as illustrated in ***Figure 5***. The label in the button turns black to show that the scene is selected.

In ***Figure 6***, the Music Player also had buttons bound to the images:

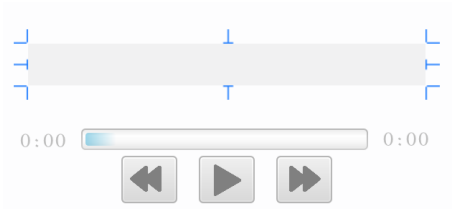


Figure 6: Multi-Media Player Buttons, Progress Bar & Labels

The placeholder text in the song's title, artist, and album label was also removed to make the music player look cleaner when no songs are in the app. The FX:IDs of all these labels have been appended to later be referenced in the Back-End[***3.2***].

The development process of the music player application initially included a feature that tracked play counts for each artist, this is portrayed in ***Figure 2***. This feature was designed to provide insights into the most frequently played artists, similar to tracking play counts for individual songs. ***Figure 7*** shows that the Frequently Played Artists were removed and replaced by more HBoxs for frequently played songs:

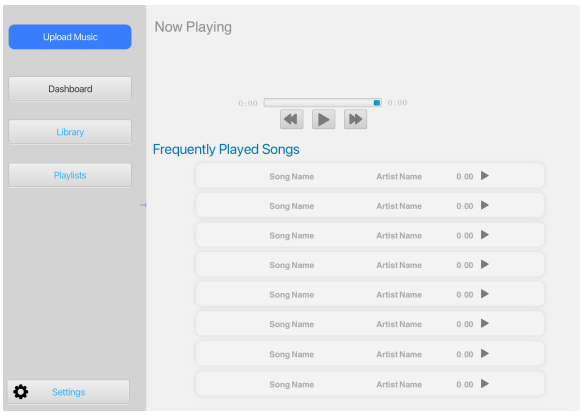


Figure 7: Removal of Frequently Played Artists (Final Product of the Dashboard in Scenebuilder)

A significant issue was that the app also allows users to edit metadata, including the artist's name. As a result, each time an artist's name was edited, the play counts map needed to be updated to reflect these changes. This not only increased the complexity of the back-end logic but also introduced the potential for errors and inconsistencies in tracking artist plays. Therefore, this feature was removed.

To create the other scenes: Library.FXML and Playlist.FXML - from the Main.FXML file, the frequently played section was removed giving a template for the scenes to be created shown in ***Figure 8***:

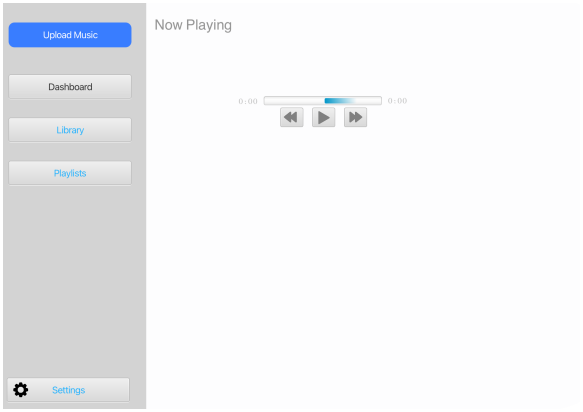


Figure 8: Template for the other FXML files created from Main.FXML

3.1.2.1 -Library.FXML

Using the template from ***Figure 8*** saves a lot of time, all that needs to be implemented is the library as all FX:IDs and on-action methods are copied over from the previous scene.

To implement the library, we use a TableView with five cells (Songs, Artists, Album, Year, Add To Playlist) all with their respective FX:IDs to be referred to later in the Back-End[***3.2***] when we want to populate this table.

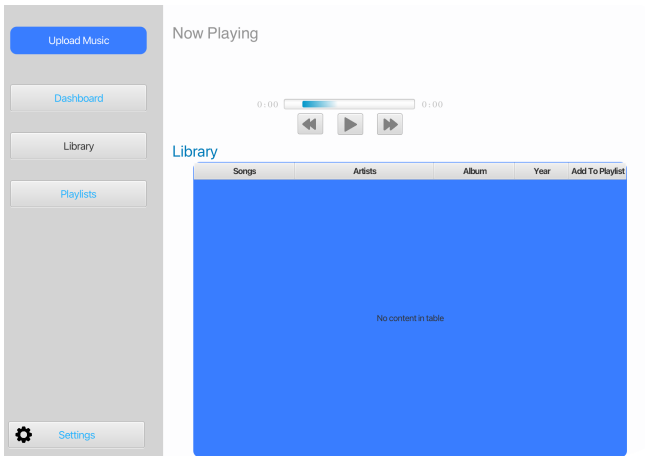


Figure 9: Completed Library scene in SceneBuilder

The Library label in ***Figure 9*** is made black to show it is the selected scene.

3.1.2.2 -Playlists.FXML

To implement Playlist.FXML, the template made by Main.FXML could have been used. However, a lot of time can be saved using the new Library.FXML file as a template for Playlist.FXML. This is because they both use a "TableView" to display songs.

So, with this new template, a new cell is added "Remove" which is linked to the new FX:ID. This cell is used to remove songs from the playlist, this functionality is explained in Chapter ***3.2.6.5.***

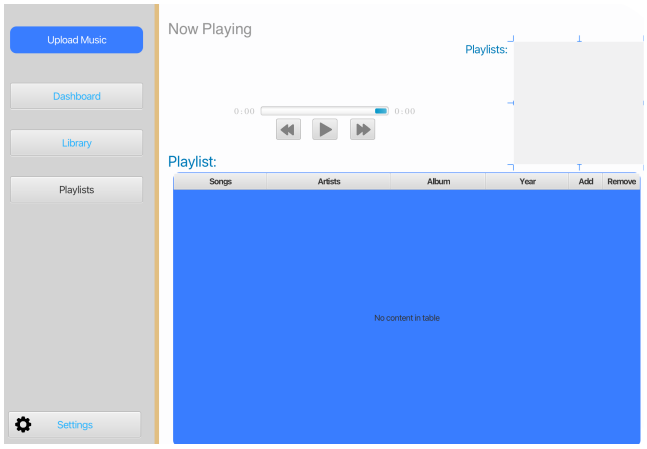


Figure 10: Completed Playlist scene in SceneBuilder

A component can be seen in the top right of ***Figure 10***, that can be mistaken with an ImageView. This is a FlowPane. It is used as a container to contain the playlist buttons when a new playlist is created. Users will be able to click the buttons to load each playlist using the viewSongsOf() method in ***Figure 61***.

3.1.2.3 - Application.CSS

CSS files can be used for styling certain components of the application as seen in ***Figure 11***:

```
.sidebar{
        -fx-background-color: #d3d3d3;
}
.upload-music-btn{
        -fx-background-color: #397DFF;
        -fx-background-radius: 10px;
}

.white-round-strip{
        -fx-background-color: #fff;
        -fx-background-radius: 10px;
        }
```

Figure 11: CSS commands used for styling FXML files

The components of the file edits are:

- .sidebar - Makes the sidebar a light grey colour
- .upload-music-btn - Makes the upload music button blue and rounded on the corners.
- .white-round-strip - Used for the HBoxs in Main.FXML[***Figure 12***], rounding off on the corners.

The CSS styling was used for certain components where a specific look was wanted.

3.1.3 - Final Product of Front-End when the Application is Ran

3.1.3.1 - Main.FXML

Figure 12 is the main dashboard for the RetroSonic application, it is loaded up first by Main.java by default, and it can be switched to by using the switchToMain() method in ***SceneController.Java***[***3.2.6.4a***] activated by the Dashboard button:

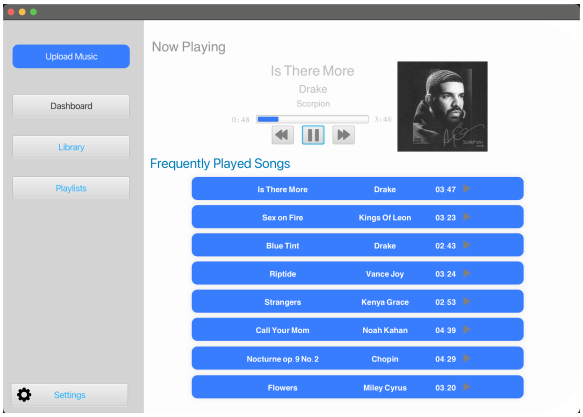


Figure 12: Dashboard of the application running

3.1.3.2 - Library.FXML

Figure 13 is the library scene of the application, it is switched to by using the switchToLibrary() method in ***SceneController.Java***[***3.2.6.4b***] activated by the Library button:

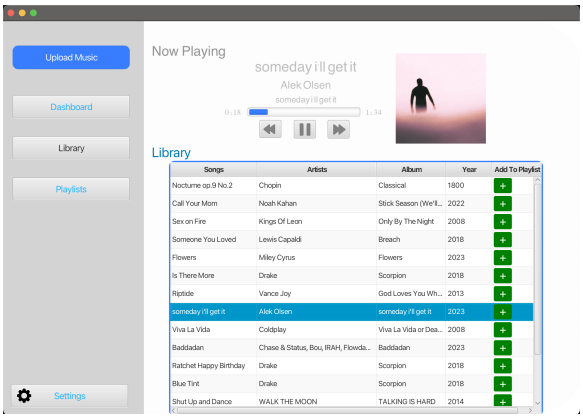


Figure 13: Library of the application running

Songs in the TableView can be double-clicked to be played due to the doubleClickOnTableView() method in the ***SceneController***, mentioned in Chapter *3.2.6.2*[*Figure 49*]

Each cell of the TableView can be adjusted to be viewed in alphabetical order or chronologically in the case of year:

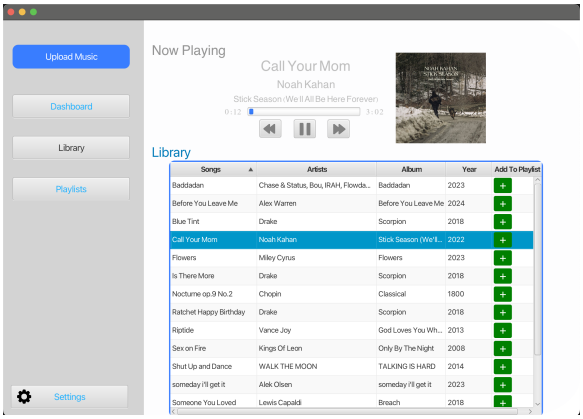


Figure 14: Adjusting Cells to order songs in alphabetical order

It can also present songs, artists, albums in reverse alphabetical order (Z-A) and the years in reverse chronological order:

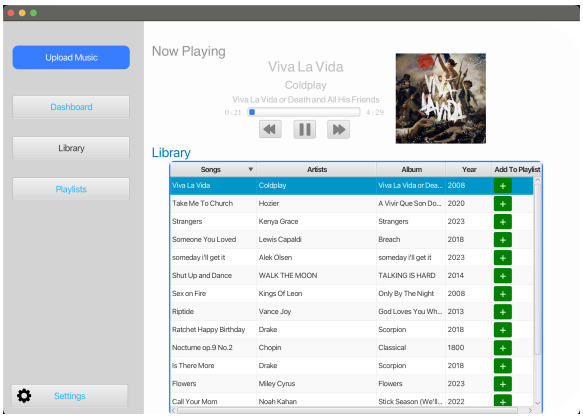


Figure 15: Adjusting Cells to order songs in reverse alphabetical order

The app also gives default values for songs which don't have metadata tags, this is implemented in ***Song.java***. This allows for songs to be represented like this:

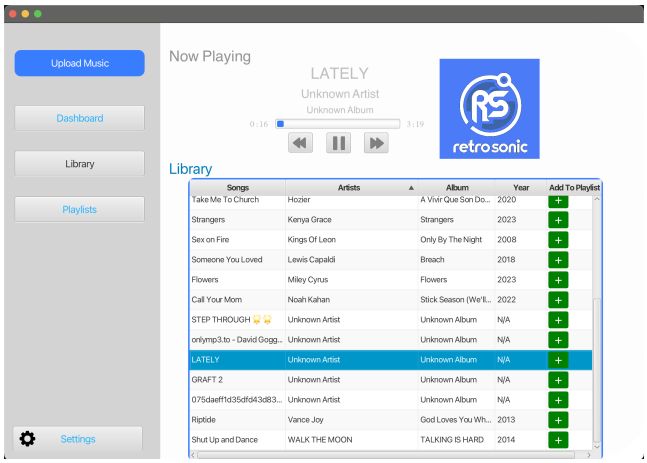


Figure 16: Default Values are given to songs with a lack of metadata tags

As can be seen in ***Figure 16***, when there are no metadata tags, a default image is placed and default values are assigned to fill in the table view cells and the media player labels.

3.1.3.3 - Playlist.FXML

Figure 17 is the playlist scene of the application, it is switched to using the switchToPlaylist() method in ***SceneController.Java***[***3.2.6.4c***] activated by the Playlists button:

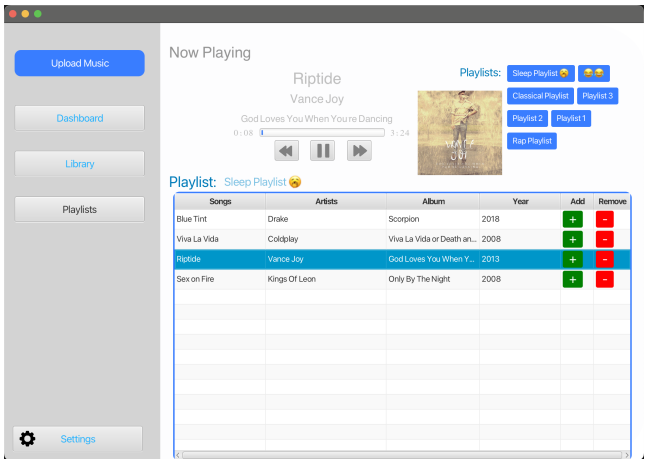


Figure 17: Playlist scene of the application running

The playlists are displayed as buttons in the top right in a FlowPane. The user can press a button to select one and it will populate the table using the viewSongsOf() method in Chapter ***3.2.6.5***[***Figure 61***]. The functionality to add songs to different playlists still exists, songs can be removed from playlists also using the "*Remove*" cell. Songs can still be double-clicked in the table to be selected.

3.1.3.4 - Dialogue Screens

a)Upload Music Button:

When the "*Upload Music*" Button is clicked, its embedded method is the uploadMusicAction() within ***SceneController.Java*** [***3.2.6.3***][***Figure 51***], it opens up the directory for the user to select songs:

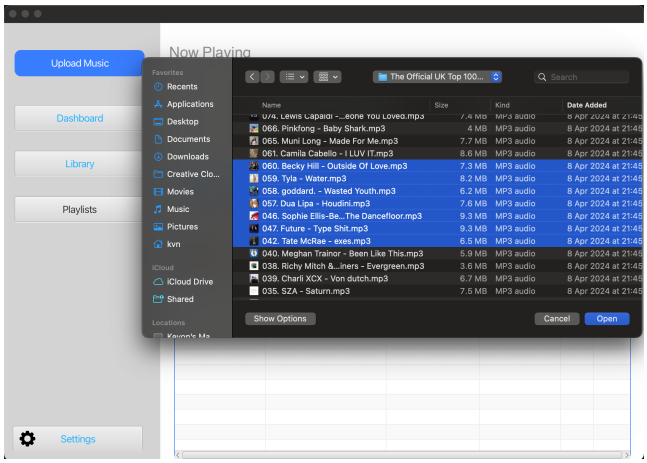


Figure 18: Selecting songs to be uploaded to the application

This allows users to upload an MP3 file or a directory of MP3 files so that the user doesn't have to upload songs one by one.

***b)Playlists*:**

When the "*Add to Playlist*" Button is clicked on Library.FXML or the "*Add*" Button is clicked on Playlists.FXML, it uses the showAddToPlaylistDialog() method in the ***SceneController.Java***[*3.2.6.5*][*Figure 64*], causing the dialogue box in *Figure 19* to pop up:

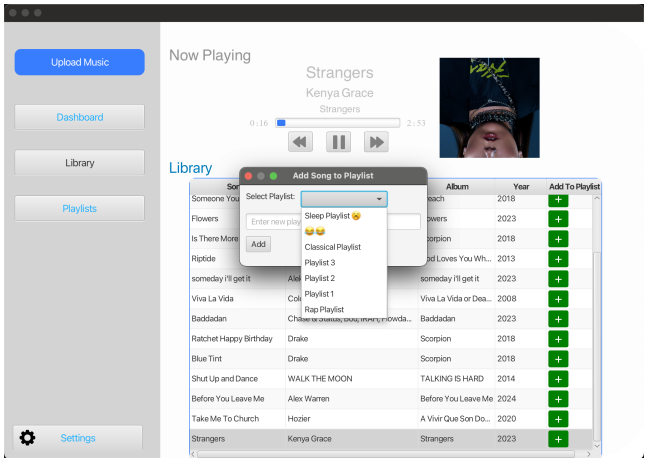


Figure 19: Adding song a new or existing playlists

The user has the ability to type a new playlist name in the text field or they can select a playlist that has already been created to add the selected song.

***c)Settings*:**

When the Settings Button on the sidebar is pressed, the showEditMetadataDialogue() method activates [*3.2.6.6*][*Figure 66*], causing the dialogue box in *Figure 20* to pop up with the ability to edit the currently selected song:

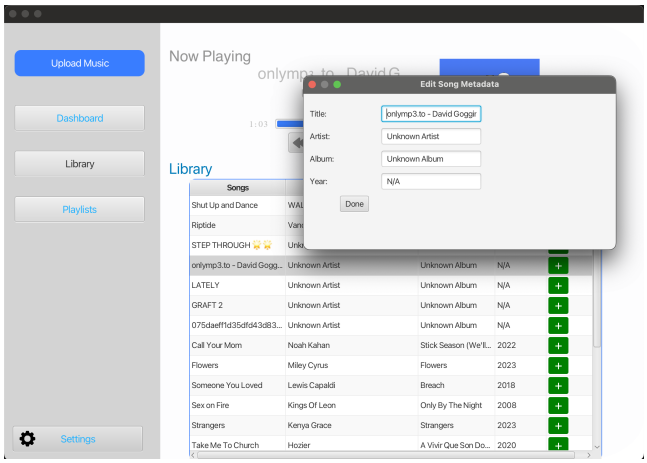


Figure 20: Dialog Box to edit the currently selected song

As can be seen in the ***Figure 20*** the song has not been embedded with tags and has been given default values shown in the text fields.

These text fields can be edited as such to fill in tags for songs which are tagless.

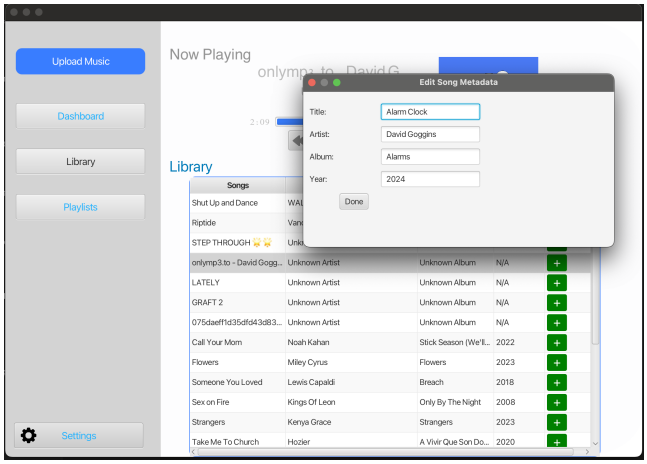


Figure 21: Changing the metadata values of the song

In ***Figure 21***, the metadata in the fields have been edited to something more appropriate to the song.

When the “Done” button is selected, the changes are made permanent, due to the ***MP3TagWriter.java***[***3.2.3***] class, which takes advantage of the external MP3agic library’s extensive setter methods[***12***]:

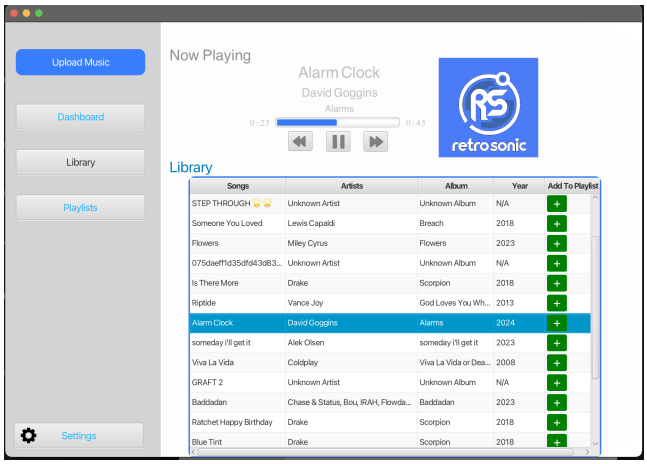


Figure 22: Metadata changes are made final and can be viewed in the library

As witnessed in ***Figure 22***, the changed tags are made apparent once the scene is refreshed. These tags differ from the original tags of the song in ***Figure 20***.

3.2 - Back-End

The Back-End was developed after the Front-End[***3.1***]. This was so that the respective FX:IDs could be linked by initialising them within the code.

An example of this:

```
@FXML
private Label songLabel
@FXML
private TableView songLibrary
```

This allowed these Front-End components to be referred to within the code so that they could be referred to in methods to display/update the song details or to populate the table with songs.

The process of development started with the ***Song*** class[***3.2.4***] where the variables like the title, song art, and artist are extracted. The development then moved onto the ***GlobalMediaPlayer***[***3.2.5***] class where the initial multimedia player functionality came from with the ability to play ***Song*** objects. The ***MP3TagWriter***[***3.2.3***] class was developed near the end of the project as it required solidarity of the previous classes before introducing this class which has the potential to cause a lot of errors by manipulating the music library.

The ***SceneController***[***3.2.6***] was developed alongside these classes, it contains the FXML variables of the front-end and progressively updates them using the methods from the other classes like using ***Song*** getter methods to update song labels or initialising ***GlobalMediaPlayer*** methods for media playback.

In this project report, the UML design is strategically discussed in Chapter ***3.2.7***, immediately following the comprehensive coverage of the Back-End. This placement is intentional and beneficial as it allows the reader to have a contextual understanding of the discussion in section ***3.2.7.1,*** about the design and what improvements could be made.

3.2.1 - Environment

Figure 23 is the directory of RetroSonic within Eclipse. Eclipse was my chosen environment for this project due to my experience using it from ***COMP201-Software Engineering 1***. I am using Eclipse with the e(fx)clipse 3.8.0 plugin set which is used to support the experience of JavaFX on Eclipse:

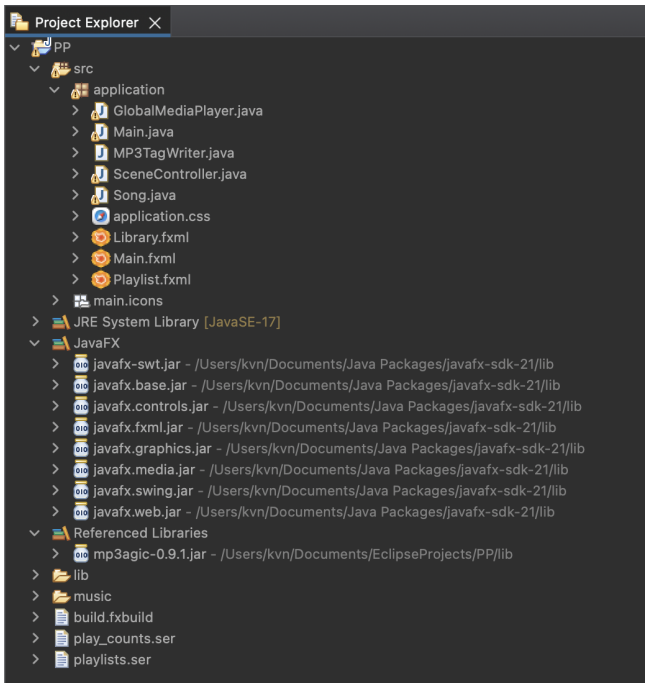


Figure 23: Directory of the Music Player Application within Eclipse

The file directory is named PP, originally after the previous name given to the application (PurePlay), before deciding the name RetroSonic was more appropriate.

Within this folder are:

- Libraries
  - JRE - Used for running Java applications by providing Java Runtime Environment
  - JavaFX[**5**] - Used for creating UI and implementing the MediaPlayer API
  - Mp3Agic[**10**]- Supports handling and manipulation of MP3 metadata directly. Used within ***Song.java*** to extract metadata and within ***MP3tagwriter.java*** to write tags effectively.
- Serialisable Files; Contains the Persistent Data. Data is serialised to the file when the session is complete, then deserialised to be used when the app is run again
  - play_counts.ser - used for persistently saving data of how many times a song is played, to display frequently played songs in Main.FXML. This file is made in the saveFrequentlyPlayedList() method in ***GlobalMediaPlayer.java***.
  - playlists.ser - used for saving playlists persistently to display them in Playlist.FXML. This file is made by the savePlaylists() method in ***SceneController.java***.
- build.fxbuild - an automatically created file made by JavaFX environment within Eclipse.
- Application Files
  - Front-End
    - Main.FXML - Dashboard
    - Library.FXML - Library
    - Playlist.FXML - Playlists
    - Application.CSS - Styling for Front-End of Application
  - Back-End
    - Main.Java - Starts application by loading Main.FXML

- GlobalMediaPlayer.Java - Controls all music playback and frequently played songs
- SceneController.java - Controls all interaction with Front-End by giving buttons their respective methods on the Back-End.
- Song.Java - Extracts metadata of songs using MP3agic and gives default values for songs with no tags.
- MP3TagWriter.Java - Used to set metadata tags of songs using MP3agic library.

Configurations

Figure 24 shows the Virtual Machine arguments used for configuring the JavaFX runtime when launching the application:

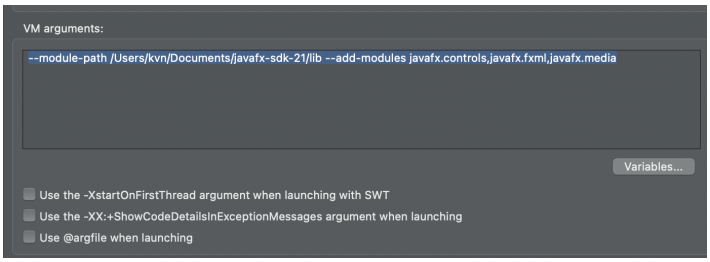


Figure 24: Run Configurations for the Application

The first part "—module-path" sets the module path for the application. The module path is where the Java Runtime looks for modules to load, it currently points to the JavaFX-SDK library folder containing the JavaFX modules for this application.

The second part "—add-modules" specifies which modules to run at runtime, currently, this is:

- .controls - supports user interface controls such as buttons & tables
- .fxml - supports loading user interface defined in fxml files.
- .media - supports the multimedia components: the media player & playback of audio.

These configurations allow the application to be run by giving it access to the required modules.

3.2.2 - Main.Java

Figure 25 is the extent of Main.Java:

```
1  package application;
2
3  import javafx.application.Application;
9
10
11 public class Main extends Application {
12     @Override
13     public void start(Stage primaryStage) {
14         try {
15             Parent root = FXMLLoader.load(getClass().getResource("Main.fxml"));
16             Scene scene = new Scene(root);
17             scene.getStylesheets().add(getClass().getResource("application.css").toExternalForm());
18             primaryStage.setScene(scene);
19             primaryStage.show();
20         } catch(Exception e) {
21             e.printStackTrace();
22         }
23     }
24
25     public static void main(String[] args) {
26         launch(args);
27     }
28 }
29
```

Figure 25: Main Class which starts the application

The JavaFX application's main entry point is the start() method:

1. It implements FXMLLoader to load in Main.FXML file, containing the User Interface & initialises it into a Parent object. This is the root of the scene graph for the window.
2. A new scene is then created from the Parent root which is then a container for all content in the stage.
3. This scene then adds the stylesheet from Application.css for styling the Front-End.
4. This new scene is then set onto the primary stage

5. Then the primary stage is displayed for the user.

This setup clearly separates the application's configuration and startup sequence into well-organised blocks, making use of JavaFX's capabilities to load and style the user interface declaratively using FXML and CSS.

3.2.3 - MP3TagWriter.Java

The ability to edit the metadata of the song wasn't originally planned in the detailed proposal it was a later feature that felt like a necessary addition for users to fully manipulate their music library. Therefore, the MP3TagWriter class was implemented to focus on this manipulation of metadata.

The ***MP3TagWriter*** class implements the MP3agic library to take advantage of the setter methods[***12***] (to edit Title, Artist, Album, and Year) which is shown in ***Figure 26***:

```
public class MP3TagWriter
{
    public static void setTitle(Song song, String newTitle) throws NotSupportedException, IOException {
        try
        {
            Mp3File mp3file = new Mp3File(song.getFilePath());
            ID3v2 tag = getOrCreateId3v2Tag(mp3file);
            tag.setTitle(newTitle);
            saveMp3File(mp3file, song.getFilePath(), "temp_title.mp3");  // Using a temporary file for saving
        }
        catch (Exception e) {
            e.printStackTrace();
        }
    }

    public static void setArtist(Song song, String newArtist) throws NotSupportedException, IOException {
        try
        {
            Mp3File mp3file = new Mp3File(song.getFilePath());
            ID3v2 tag = getOrCreateId3v2Tag(mp3file);
            tag.setArtist(newArtist);
            saveMp3File(mp3file, song.getFilePath(), "temp_artist.mp3");  // Using a temporary file for saving
        }
        catch (Exception e) {
            e.printStackTrace();
        }
    }

    public static void setAlbum(Song song, String newAlbum) throws NotSupportedException, IOException {
        try
        {
            Mp3File mp3file = new Mp3File(song.getFilePath());
            ID3v2 tag = getOrCreateId3v2Tag(mp3file);
            tag.setAlbum(newAlbum);
            saveMp3File(mp3file, song.getFilePath(), "temp_album.mp3");  // Using a temporary file for saving
        }
        catch (Exception e) {
            e.printStackTrace();
        }
    }

    public static void setYear(Song song, String newYear) throws NotSupportedException, IOException {
        try
        {
            Mp3File mp3file = new Mp3File(song.getFilePath());
            ID3v2 tag = getOrCreateId3v2Tag(mp3file);
            tag.setYear(newYear);
            saveMp3File(mp3file, song.getFilePath(), "temp_year.mp3");  // Using a temporary file for saving
        }
        catch (Exception e) {
```

Figure 26: MP3TagWriter Class used to edit metadata

The currently selected song's 4 edited text fields from the Edit Metadata Settings Dialogue Screen [***3.1.3.4c***] are taken as parameters for setTitle, setArtist, setAlbum & setYear respectively.

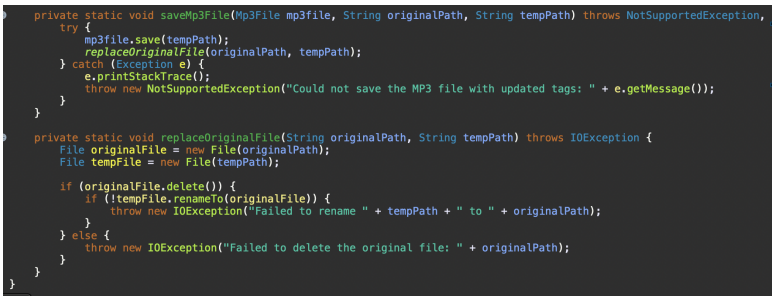
This is where the song's file path is used to initialise an MP3File object - this object is used for modification.

In ***Figure 27***, the getOrCreateId3v2Tag() method reads the current Id3v2Tag of the song to the tag variable or creates one if it doesn't yet exist:

```
    private static ID3v2 getOrCreateId3v2Tag(Mp3File mp3file) {
        ID3v2 tag = mp3file.getId3v2Tag();
        if (tag == null) {
            tag = new ID3v24Tag();
            mp3file.setId3v2Tag(tag);
        }
        return tag;
    }
```

Figure 27: Creating a new tag if the song doesn't contain any

In ***Figure 28***, the input from the text field is then set onto the tag. The modified MP3 file is then saved to a temporary file. This temporary file then replaces the original source file:

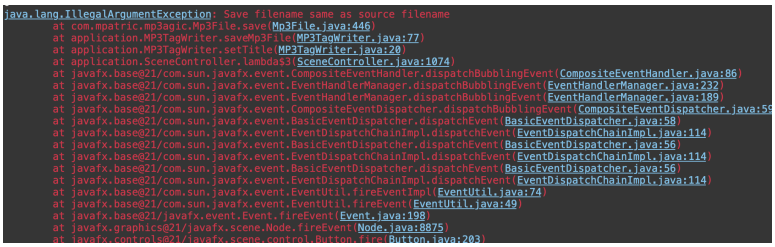


```
    private static void saveMp3File(Mp3File mp3file, String originalPath, String tempPath) throws NotSupportedException,
        try {
            mp3file.save(tempPath);
            replaceOriginalFile(originalPath, tempPath);
        } catch (Exception e) {
            e.printStackTrace();
            throw new NotSupportedException("Could not save the MP3 file with updated tags: " + e.getMessage());
        }
    }

    private static void replaceOriginalFile(String originalPath, String tempPath) throws IOException {
        File originalFile = new File(originalPath);
        File tempFile = new File(tempPath);

        if (originalFile.delete()) {
            if (!tempFile.renameTo(originalFile)) {
                throw new IOException("Failed to rename " + tempPath + " to " + originalPath);
            }
        } else {
            throw new IOException("Failed to delete the original file: " + originalPath);
        }
    }
}
```

Figure 28: Replacing the Original File

The result is the original file with permanent changes in its metadata tags. This replacement process is done to avoid corruption of the original file during the save operation.

Without the method in ***Figure 28***, the error displayed in ***Figure 29*** was consistently flaring when trying to change metadata:



```
java.lang.IllegalArgumentException: Save filename same as source filename
        at com.mpatric.mp3agic.Mp3File.save(Mp3File.java:446)
        at application.MP3TagWriter.saveMp3File(MP3TagWriter.java:77)
        at application.MP3TagWriter.setTitle(MP3TagWriter.java:20)
        at application.SceneController.lambda$3(SceneController.java:1074)
        at javafx.base@21/com.sun.javafx.event.CompositeEventHandler.dispatchBubblingEvent(CompositeEventHandler.java:86)
        at javafx.base@21/com.sun.javafx.event.EventHandlerManager.dispatchBubblingEvent(EventHandlerManager.java:232)
        at javafx.base@21/com.sun.javafx.event.EventHandlerManager.dispatchBubblingEvent(EventHandlerManager.java:189)
        at javafx.base@21/com.sun.javafx.event.CompositeEventDispatcher.dispatchBubblingEvent(CompositeEventDispatcher.java:59
        at javafx.base@21/com.sun.javafx.event.BasicEventDispatcher.dispatchEvent(BasicEventDispatcher.java:58)
        at javafx.base@21/com.sun.javafx.event.EventDispatchChainImpl.dispatchEvent(EventDispatchChainImpl.java:114)
        at javafx.base@21/com.sun.javafx.event.BasicEventDispatcher.dispatchEvent(BasicEventDispatcher.java:56)
        at javafx.base@21/com.sun.javafx.event.EventDispatchChainImpl.dispatchEvent(EventDispatchChainImpl.java:114)
        at javafx.base@21/com.sun.javafx.event.BasicEventDispatcher.dispatchEvent(BasicEventDispatcher.java:56)
        at javafx.base@21/com.sun.javafx.event.EventDispatchChainImpl.dispatchEvent(EventDispatchChainImpl.java:114)
        at javafx.base@21/com.sun.javafx.event.EventUtil.fireEventImpl(EventUtil.java:74)
        at javafx.base@21/com.sun.javafx.event.EventUtil.fireEvent(EventUtil.java:49)
        at javafx.base@21/javafx.event.Event.fireEvent(Event.java:198)
        at javafx.graphics@21/javafx.scene.Node.fireEvent(Node.java:8875)
        at javafx.controls@21/javafx.scene.control.Button.fire(Button.java:203)
```

Figure 29: Error caused by not using the methods in Figure 28

This is also a small downside of MP3agic which is that cannot write changes to an MP3 file directly (in-place modification). I was considering using a different library such as Jaudiotagger which supports in-place modification[***15***]. This would lead to fewer lines of code, however, research into in-place editing reveals that it is risky and not generally recommended because of the potential for data loss if an error occurs during the write process. It is safer to write to a temporary file and then replace the original file after the write is successful, like what is used in ***Figure 28***'s saveMP3File() method.

3.2.4 - Song.Java

In ***Figure 30***, the ***Song*** Class implements the Serializable interface to allow the object to get serialised for the persistent capabilities of the application:

```
public class Song implements Serializable
{
    private String title;
    private String artist;
    private String album;
    private String year;
    private String duration;
    private File file;
    private transient Image albumArt;//stop it getting serialised into song data

    // Constructor
    public Song(File file)
    {
        // Initialize with default values
        this.title = "";
        this.artist = "";
        this.album = "";
        this.year = "";
        this.file = file;

        extractMetadata();
        extractAlbumArt();
    }
```

Figure 30: Song Class with a constructor to extract metadata

The albumArt image is made transient to avoid serialisation of the image. This is to avoid a notSerializableException error caused by trying to serialise the image which is illustrated by ***Figure 31***:

Figure 31: Error caused by not making image transient, shown in Figure 30

This is because images are not serialisable in Java by default due to images being large and complex[***14***]. This deficiency does not command any shortcomings, however, if necessary there exists methods to bypass this like using a BufferedImage to handle the pixel data into a format that can be easily serialised:

```
public byte[] serializeImage(BufferedImage img) throws IOException {
    ByteArrayOutputStream stream = new ByteArrayOutputStream();
    ImageIO.write(img, "png", stream);
    return stream.toByteArray();
}
```

The ***Song*** Class also imports the MP3agic library to take advantage of its getter methods[***12***]: to extract the metadata and song art of each song. This is done using the extractMetadata() and extractAlbumArt() methods[***Figure 32***] which are activated in the constructor[***Figure 30***]:

```
private void extractMetadata() {
    try {
        Mp3File mp3file = new Mp3File(this.file.getPath());
        String name = file.getName();//Incase file has no title
        name = name.substring(0, name.length() - 4);//remove .mp3

        if (mp3file.hasId3v2Tag()) {
            ID3v2 id3v2tag = mp3file.getId3v2Tag();
            title = id3v2tag.getTitle() != null ? id3v2tag.getTitle() : name;
            artist = id3v2tag.getArtist() != null ? id3v2tag.getArtist() : "Unknown Artist";
            album = id3v2tag.getAlbum() != null ? id3v2tag.getAlbum() : "Unknown Album";
            year = id3v2tag.getYear() != null ? id3v2tag.getYear() : "N/A";
            // ID3v2 might also contain more info such as comments, genre, etc.
        } else if (mp3file.hasId3v1Tag()) {
            // Some older files might only have ID3v1 tags
            ID3v1 id3v1tag = mp3file.getId3v1Tag();
            title = id3v1tag.getTitle() != null ? id3v1tag.getTitle() : name;
            artist = id3v1tag.getArtist() != null ? id3v1tag.getArtist() : "Unknown Artist";
            album = id3v1tag.getAlbum() != null ? id3v1tag.getAlbum() : "Unknown Album";
            year = id3v1tag.getYear() != null ? id3v1tag.getYear() : "N/A";
        }

        // Extract duration
        long durationSeconds = mp3file.getLengthInSeconds();
        duration = String.format("%02d:%02d", durationSeconds / 60, durationSeconds % 60);
    }
    catch (Exception e)
    {
        e.printStackTrace();
    }
}


private void extractAlbumArt()
{
    try
    {
        Mp3File mp3file = new Mp3File(this.file.getPath());
        if (mp3file.hasId3v2Tag())
        {
            ID3v2 id3v2tag = mp3file.getId3v2Tag();
            byte[] imageData = id3v2tag.getAlbumImage();
            if (imageData != null) {
                this.albumArt = new Image(new ByteArrayInputStream(imageData));
            }
            else
            {
                this.albumArt = new Image(getClass().getResourceAsStream("/main/icons/Logo.png"));
            }
        }
    }
    catch (IOException | UnsupportedTagException | InvalidDataException e)
    {
        e.printStackTrace();
    }
}
```

Figure 32: Extract metadata/album art method used in Figure 30

These methods initialise a new Mp3File object from the song file path, and then from the tags, they extract the metadata from the song file and assign it to the respective variables. If the tag extracted is null, a default value is used in its place. If the artist, album and year variables are null ⇒ “Unknown Artist/Album” or “N/A” is used. If the title is null, the last thing the user wants is to end up with 10 different songs called “Unknown Song”. Therefore, the extractMetaData() method in ***Figure 32*** gets the file name of the song and removes the last 4 letters to get the filename without the “.mp3” extension. This file name lacking the extension is now used as the default title if the title tag is vacant.

The extractAlbumArt() method[*Figure 32*] implements a default image from the icons folder, in the cases where the image is null. This logo was designed in Gimp[***16***]:

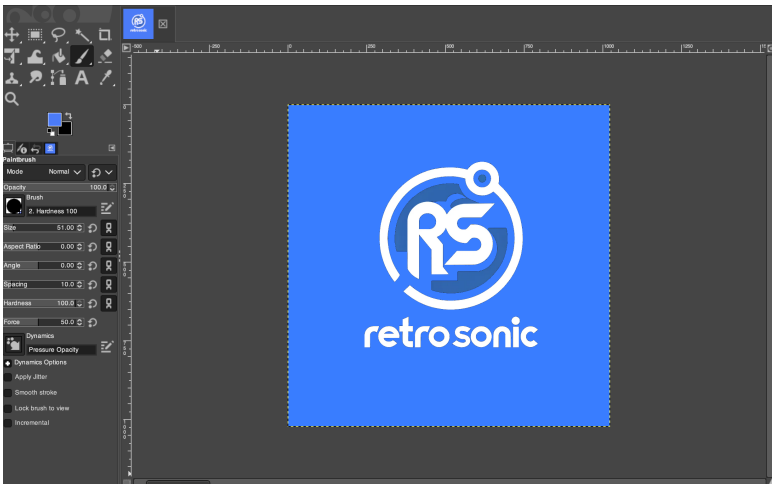


Figure 33: RetroSonic Logo used for the application made in GIMP

The logo was made to be simple and eye-catching. It uses the same blue (#397DFF) colour as the TableView, the Playlist buttons & the Upload Music button on the Front-End[*3.1.3.4a*]. This colour coding abides by a Simplified User Interface where minimum colours should be used so that no one component stands out more than another on the music player[***10***].

3.2.5 - GlobalMediaPlayer.Java

The ***GlobalMediaPlayer*** class loads in the song data using the loadSongs() method in *Figure 34* and these songs were previously loaded in to the application from the music directory through the loadSongs() method in the ***SceneController*** class as array<files> which then gets turned into an observable list of ***Song*** objects:

```
public class GlobalMediaPlayer implements Serializable
{
    private static MediaPlayer mediaPlayer;
    private static Media media;

    private static String songName;
    private static int songIndex;
    private static ObservableList<Song> songs;

    private static boolean isPlaying = false;

    private static Map<Song, Integer> playCounts = new HashMap<>();// initialises a map wi
    private static final String PLAY_COUNTS_FILE = "play_counts.ser";//for frequently play


    //Imports the songs from SceneController.java
    public static void loadSongs(ObservableList<Song> songData)
    {
        songs = songData;
    }
```

Figure 34: GlobalMediaPlayer Class implementing Serializable like Song Class[Figure 30]

If I were to implement the Application from the start, there would be two better choices:

- Initialise all the song data into the ***GlobalMediaPlayer*** class avoiding it being stored in the ***SceneController*** then create the instance the same way through the song number. This would save memory in the application causing it to run quicker. However, the change could not have been made at the late stage I noticed it, due to the highly coupled code between the song data stored within the controller and the frequently played song functionality.
- Initialise the song data & song number as global variables to allow access from all classes. This option is the best, allowing us to remove a lot of the complexity & stop having to track the song number between the Classes to know which song is being played. The reason this was not done was because the application was getting to the late implementation stage and this change would not bring a change in functionality in the front-end, rather it would remove a layer of complexity from the back-end, which cannot be seen by a user of the app.

These are more viable options to keep in mind when building an application like this.

The reason an ObservableList is used is because it automatically updates the UI elements that are bound to it whenever added, removed or modified within the list[***17***]. For example, a ***Song*** object has properties such as title, artist, album & year that are displayed and edited through the application's interface [***3.2.6.6***]. Changes to these properties can be automatically propagated through the application. I believe this variable type was the right choice, however, the choice to have both classes hold the song data was wrong.

The ***GlobalMediaPlayer*** also implements the Singleton Design pattern, that was studied in ***COMP319-Software Engineering 2***. It is used throughout its initialisation to avoid multiple instances of the same object being created:

```
//Singleton instance of the controller for a specific song (Switching scenes)
public static MediaPlayer getInstance(int songNumber)
{
    songIndex = songNumber;
    if (mediaPlayer == null)
    {
        media = songs.get(songNumber).getMedia();//
        mediaPlayer = new MediaPlayer(media);
    }
    else
    {
          mediaPlayer.stop();
          mediaPlayer.dispose();
          Media media = new Media(songs.get(songNumber).toURI().toString());
          mediaPlayer = new MediaPlayer(media);
    }
    return mediaPlayer;
}

public static void setNewSong(File songFile)
     {
    media = new Media(songFile.toURI().toString());
    if (mediaPlayer != null)
    {
        mediaPlayer.stop();
        mediaPlayer.dispose();
    }
    mediaPlayer = new MediaPlayer(media);

}
```

Figure 35: Implementing the Mediaplayer with a singleton pattern

The getInstance() & setNewSong() methods in ***Figure 35*** implement the singleton pattern by checking whether the MediaPlayer is null before creation. This avoids multiple of the same ***GlobalMediaPlayer*** being created at the same time which was an error. In the beginning of development, before Singleton was implemented when the scene was switched, it would duplicate the instance of the MediaPlayer causing the MediaPlayers to play songs over each other.

The media playback buttons in ***Figure 36*** also all check for the instance to be null, this is not a singleton pattern as it does not create a new instance of the media player after the check:

```
public static void play()
{
    if (mediaPlayer != null)
    {
        mediaPlayer.play();
        isPlaying=true;
    }
}
public static void pause()
{
    System.out.println("pause clicked");
    if (mediaPlayer != null)
    {
        mediaPlayer.pause();
        isPlaying=false;
    }
}
public static void stop()
{
    if (mediaPlayer != null)
    {
        mediaPlayer.stop();
        isPlaying=false;
    }
}
```

Figure 36: Media Playback buttons

However, like the singleton pattern, it does stop errors from occurring when the user tries to use the multimedia buttons on the front-end without an instance yet being created. This is useful for avoiding errors in cases where there are no songs uploaded to the application yet and the user tries using the buttons.

3.2.5.1 - Frequently Played Songs

The main portion of the functionality for creating the frequently played songs list exists within the ***GlobalMediaPlayer*** class. The class implements a hashmap of <Song, Integer> with the integer corresponding to how many times that ***Song*** object has been played.

```
private static Map<Song, Integer> playCounts = new HashMap<>();
```

The main functionality contained within the ***GlobalMediaPlayer*** Class in regards to frequently played songs are:

- ***Figure 37***'s incrementPlaycount() method, is invoked every time the updatemediaplayer() method (every time a different song is played) is invoked in the ***SceneController***[***3.2.6***]. It increments the Song's hashmap's integer by 1 every time it's played

```
public static void incrementPlayCount(Song song)
{
    int count = playCounts.getOrDefault(song, 0);
    playCounts.put(song, count + 1);//Update Map
}
```

Figure 37: Incrementing the Song's Play Count

- ***Figure 38***'s removeSongFromPlaycount() method is used to remove the song from the playcount list. This is used when songs are removed from the directory.

```
//Method to remove song from the playcount map
public static void removeSongFromPlayCount(Song song)
{
    playCounts.remove(song);
}
```

Figure 38: Removing Song from the Play Count

- ***Figure 39***'s getTopFrequentlyPlayedSongs(int n) method - integer n refers to how many hboxs are in the front-end dashboard of Main.fxml[***3.1.1***] to be filled. There are currently 8 hboxs in the front-end so n=8. This method arranges the songs into a descending order based on playcounts and then returns this list of 8 songs to be displayed. This method is invoked when the switchToMain() method is used to switch scenes to the dashboard.

```
public static List<Song> getTopFrequentlyPlayedSongs(int N)
{
    List<Song> sortedSongs = new ArrayList<>(playCounts.keySet());// new l
    sortedSongs.sort((s1, s2) -> playCounts.get(s2) - playCounts.get(s1));

    // Return the top N songs
    return sortedSongs.subList(0, Math.min(N, sortedSongs.size()));
}
```

Figure 39: Getter for the Top Frequently Played Songs

- ***Figure 40***'s saveFrequentlyPlayedList() method - this is invoked when the updateMediaPlayer() method is invoked. It allows for persistently saved data of this playcounts list. The method creates a byte stream to serialise the data into a serialisable file; "play_counts.ser", when this application is exited.
- ***Figure 40*** uses a Lambda expression to organise the play counts in descending order: it checks if song2 - song1 is positive. If it is song2 is placed before song1 because it has the higher play count. Lambda expressions enable functional programming features in Java, which is primarily an object-oriented language. They allow writing code in a declarative manner, specifying what should be done rather than detailing how it should be done, thus focusing on the logic rather than the control flow.[***18***].

```
// Method to save playCounts map to a serialised file
public static void saveFrequentlyPlayedList()
{
    try (ObjectOutputStream oos = new ObjectOutputStream(new FileOutputStream(PLAY_COUNTS_FILE)))
    {
        oos.writeObject(playCounts);//Serialise playcounts map into play_counts.ser
    }
    catch (IOException e) {
        e.printStackTrace();
    }
}
```

Figure 40: Save the Frequently Played List

- ***Figure 41***'s loadFrequentlyPlayedList method - if the user runs the app again, it will deserialise "play_counts.ser" and then save the data in the playcounts hashmap. If the file doesn't exist a new playcounts hashmap is initialised. This method is invoked on startup.

```
@SuppressWarnings("unchecked")
public static void loadFrequentlyPlayedList()
{
    try (ObjectInputStream ois = new ObjectInputStream(new FileInputStream(PLAY_COUNTS_FILE)))
    {
        playCounts = (Map<Song, Integer>) ois.readObject();//deserialise playcount map from file

    //Iteration over all the entries in the map:
        Iterator<Map.Entry<Song, Integer>> iterator = playCounts.entrySet().iterator();
        while (iterator.hasNext())
        {
            Map.Entry<Song, Integer> entry = iterator.next();
            Song song = entry.getKey();

            // Check if the song is still exists
            if (!song.isValid())
            {
                // If the song is not valid, remove it from the playCounts map
                iterator.remove();
            }
        }

    }
    catch (IOException | ClassNotFoundException e)
    {
        // If the file doesn't exist or couldn't be read, initialise an empty map
        playCounts = new HashMap<>();
    }
}
```

Figure 41: Deserialising Playcounts.ser file

The decision to use the serialised format over storing it as a JSON file was because serialising is straightforward and efficient in Java. Instead of requiring parsing like JSON, it only requires turning the data into a byte stream and then saving it in a file. This approach is highly efficient in terms of processing speed and storage space. It comes with the downside of the serialisable file not being user-friendly to read, resulting in the testing of the file being hard. However, this was not a concern that came to mind as not many tests were done on the file when creating the application and not many users are interested in reading the back-end files of an application.

3.2.6 - Scenecontroller.Java

The ***SceneController*** class's main role is to control interaction with the front-end's components and relay a response to the back-end to control the functionality of the application.

3.2.6.1 - Updating UI

In ***Figure 42***, the controller implements the Initializable interface so when a scene is loaded, the initialize() method is invoked:

```
    //Used to show which scene is selected to choose what to populate
    private static boolean fromLibrary = false;
    private static boolean fromPlaylists = false;
//This method is run every time the scene is switched
    @Override
    public void initialize(URL location, ResourceBundle resources)
    {
        //Playlists loaded from a serialised file, or if the file doesn'
        Map<String, List<Song>> p = loadPlaylists();
        playlists = p != null ? p : new HashMap<>();
        validatePlayLists();//Remove deleted songs

        System.out.print(songNumber);
        //Import songData if it's empty (first run)

        if(songData.isEmpty())
        {
            loadSongs();
            for (File file : songs)
            {
                Song song = new Song(file);
                if(song.isValid()) {
                    songData.add(song);
                }
            }
            GlobalMediaPlayer.loadSongs(songData);
        }

//Choosing which part of UI to populate:
        if(!fromLibrary && !fromPlaylists)
        {
            populateFrequentlyPlayedSongs();
        }

        if(fromPlaylists)
        {
            populatePlaylistButtons(this);
        }

        if(!songs.isEmpty())
        {
            GlobalMediaPlayer.getInstance(songNumber);
            //songLabel.setText(songs.get(GlobalMediaPlayer.getSongIndex
        }
        System.out.println(GlobalMediaPlayer.getSongIndex());//TEST
        songProgressBar.setStyle("-fx-accent: #397DFF;");//progress bar
        updateSongDetails();
```

Figure 42: Initialisation of the Scene

This method is run every time the scene is switched, if the song data is empty (first run) it will load the songs from the music directory and then load them into the ***GlobalMediaPlayer*** class allowing the ***GlobalMediaPlayer*** class to have access to the songs[***3.2.5***]**.** The context is decided from the boolean values at the top, which are set to true when the "*switchTo...*" methods are invoked to switch scenes. This allows the application to know what the current FXML scene is by using if statements to provide context on which components to populate. For Example:

```
 if(!fromLibrary && !fromPlaylist)
 {
     populateFrequentlyPlayedSongs();
}
```

This gives the ***SceneController*** the context that the initialisation is not from the library or from the playlist, therefore, it's from the dashboard, so initialise the frequently played songs. The same logic is applied for the other if statements in ***Figure 42***.

The songs details are updated every time the scene is initialised using the updateSongDetails() method, this method is invoked every time the updateMediaPlayer() method (every time the song changes) is invoked:

```java
//Update song details
    public void updateSongDetails()
    {
        Media media = GlobalMediaPlayer.getMedia();
        if (media != null)
        {
            Song song = GlobalMediaPlayer.getSong(songNumber);

            songLabel.setText(song.getTitle());
            artistLabel.setText(song.getArtist());
            albumLabel.setText(song.getAlbum());

            //Update time and bar
            songProgressBar.setStyle("-fx-accent: #397DFF;");
            beginTimer();
            Image songimage = song.getAlbumArt();

            if (songimage != null)
            {
               songArt.setImage(songimage); // Update album art.
            }
            else
            {
                // Set default image if there's no album art.
                songArt.setImage(new Image(getClass().getResourceAsStream("/main/icons/Logo.png")));
            }
            System.out.println("Testa");
        }
    }
```

Figure 43: Method to update song details on the front-end, used in Figure 42 & 45

This method checks to see if there is any media playing. If there is it extracts the details of the song using the ***Song*** class's getter methods and assigns them to the respective label. The time bar is then updated using the beginTimer() method and the song art is set.

In ***Figure 44***, the beginTimer() method takes the current time of the song over the duration to set the progress of the bar:

```java
//Method for updating the progress bar on the song
    public void beginTimer() {
        if(timer == null)
        {
            timer = new Timer();
        }
        System.out.println("Test");
        task = new TimerTask() {
            public void run() {
                Platform.runLater(() -> {//Updates UI on the JavaFX application thread
                        double current = GlobalMediaPlayer.getCurrentTime().toSeconds();
                        double end = GlobalMediaPlayer.getMedia().getDuration().toSeconds();
                        String formattedCurrent = String.format("%d:%02d", (int) current / 60, (int) current % 60);
                        String formattedEnd = String.format("%d:%02d", (int) end / 60, (int) end % 60);
                        //Update UI:
                        songLength.setText(formattedEnd);
                        timeElapsed.setText(formattedCurrent);
                        songProgressBar.setProgress(current/end);

                        //System.out.println("TEST"+current/end);
                        if(current/end == 1) { //Song is finished when current and end = 1
                            cancelTimer();
                            nextMedia();
                            beginTimer();
                        }
                    }
                );
            }
        };
        timer.scheduleAtFixedRate(task, 0, 1000);       // Schedule the task to run every second
    }
```

Figure 44: Begining the timer for the progress bar

The method checks if the timer is currently running, if it is it'll carry on using it. It activates a task which allows for the run() method to be activated every 1000ms. Inside the TimerTask run() method, Platform.runLater is run every second to update the songLength label, the timeElapsed label, and the songProgressBar. These three components get updated in the UI, how regularly is based on the number on the bottom line currently it's 1000ms. When current/end = 1, it means the song is over so the song cancels the timer then begins the next song then starts the progress bar again. This allows the player to navigate through the library without having the click "Next" everytime the song finishes playing.

In ***Figure 45***, the updateMediaPlayer() method is invoked every time the song number changes, causing a new song to be set based on this value:

```
//Sets song then plays:
    private void updateMediaPlayer()
    {
        GlobalMediaPlayer.setNewSong(songs.get(songNumber));//Song set to current songNumber
        GlobalMediaPlayer.incrementPlayCount(songData.get(songNumber));//For frequently played count
        GlobalMediaPlayer.saveFrequentlyPlayedList();//Save list

        System.out.println("fromLibrary = " + fromLibrary);//Test

        //Update icon in scene.
        if (fromLibrary)
        {
            playPauseImage.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
        }
        else if(fromPlaylists && playPauseImagePlaylist != null)
        {
            playPauseImagePlaylist.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
        }
        else if(playPauseImageMain != null)
        {
            playPauseImageMain.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
        }
        updateSongDetails();
        GlobalMediaPlayer.play();//Play set song
    }
```

Figure 45: Method to update the media player & play/pause button

It sets the new song instance then increments the current song's play count for the frequently played list, then saves that same frequently played list by serialising it into play_counts.ser ***[3.2.5]***. The playPauseimage is changed to "pause.png" ⇒ the song details are updated ⇒ then the newly set song is played.

3.2.6.2 - Music Playback Buttons

The play/pause button's main functionality is embedded within the ***GlobalMediaPlayer*** class, however, the image for the button is controlled within the ***SceneController*** class:

```
//Play & Pause Button:
    public void playMedia()
    {
        System.out.println("play button clicked " + fromLibrary);


        if (GlobalMediaPlayer.getPlaying()) //If media player is playing
        {//Update Icons:
            if (fromLibrary)
            {
                playPauseImage.setImage(new Image(getClass().getResourceAsStream("/main/icons/playbutton.png")));
            }
            else if (fromPlaylists)
            {
                playPauseImagePlaylist.setImage(new Image(getClass().getResourceAsStream("/main/icons/playbutton.png")));
            }
            else
            {
                playPauseImageMain.setImage(new Image(getClass().getResourceAsStream("/main/icons/playbutton.png")));
            }
            GlobalMediaPlayer.pause();//If playing n button clicked, pause
        }
        else //Not playing
        {//Update Icons:
            if (fromLibrary)
            {
                playPauseImage.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
            }
            else if (fromPlaylists)
            {
                playPauseImagePlaylist.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
            }
            else
            {
                playPauseImageMain.setImage(new Image(getClass().getResourceAsStream("/main/icons/pause.png")));
            }
            beginTimer();

            if (GlobalMediaPlayer.getMedia() != null)
            {
                GlobalMediaPlayer.play();
            }
            else
            {
                updateMediaPlayer();//Both methods will play when button clicked
            }
        }
    }
```

Figure 46: Method to play song and adjust the play/pause button

Figure 46's basic logic is that if the media player is playing it will present the "playbutton.png" and if it's not playing it shows the "pause.png". The playButtonImage ImageView's FX:ID has been varied slightly across fxml files. However, if I were to redo the project it would be beneficial to reduce the lines of code by keeping the FX:IDs the same and then using the same logic:

```
if (GlobalMediaPlayer.getPlaying())
{
    playPauseImage.setImage(new Image(getClass().getResourceAsStream(".../play.png")))
}
else
{
```

```
    playPauseImage.setImage(new Image(getClass().getResourceAsStream(".../pause.png")))
}
```

Evidently, this method is much shorter now, a lot of redundancy has been removed and the functionality remains the same.

The previousMedia() and nextMedia() methods work within the same logic as each other:

```
//Previous Song Button:
    public void previousMedia()
    {
        System.out.println("songN in previousMedia " + songNumber);

        if(fromPlaylists)
        {
            int index = tableView2.getSelectionModel().getSelectedIndex();//Current index
            if (index > 0) //Check if it's first song
            {
                index--;
            }
            else //If it's first song, loop back round
            {
                index = playListData.size() - 1;
            }
            songNumber = getSongNumberOf(playListData.get(index));//Update songNumber
            tableView2.getSelectionModel().select(index);//select in UI

        }
        else
        {
            if (songNumber > 0) //Check first song
            {
                songNumber--;
            }
            else //if it is loop back
            {
                songNumber = songs.size() - 1;
            }

        }
        updateMediaPlayer();//plays new song
```

Figure 47: Previous Song Method

```
//Next Song Button:
    public void nextMedia() //Same context as the previousMedia
    {
        if(fromPlaylists)
        {
            int index = tableView2.getSelectionModel().getSelectedIndex();
            if (index < playListData.size() - 1)
            {
                index++;
            } else
            {
                index = 0;
            }
            tableView2.getSelectionModel().select(index);

            songNumber = getSongNumberOf(playListData.get(index));
        }
        else
        {
            if (songNumber < songs.size() - 1)
            {
                songNumber++;
            }
            else
            {
                songNumber = 0;
            }
        }
        updateMediaPlayer();
    }
```

Figure 48: Next Song Method

The methods in ***Figure 47*** & ***Figure 48*** allow for the previous & next songs to be played but the key feature is the loop. The controller checks the current index against the size of the list of songs or if it's from the Playlist scene, against the size of the playlist. If the index is the last song of the playlist and the nextMedia() method is invoked it will loop around to the first song so index = 0. If it's the first song and the previousMedia() method is invoked then it loops around to the last song of the playlist which is either songs.size()-1 or playlistData.size()-1 depending on the scene context.

Songs can also be double-clicked in the Library or Playlist TableView to be played using this method in ***Figure 49***:

```
//If song is double clicked start playing
    public void doubleClickOnTableView(MouseEvent event)
    {
        if(event.getClickCount() == 2)
        {
            System.out.println("clicked twice");
            songNumber = tableView != null ? tableView.getSelectionModel().getSelectedIndex() :
                getSongNumberOf(tableView2.getSelectionModel().getSelectedItem());
            updateMediaPlayer();
        }
    }
```

Figure 49: Playing song in the TableView by double-clicking

When a song is double clicked the song number of the song from the selected row will be assigned as the song number and the updateMediaPlayer() method[] is invoked to set the new song, update details and increment the song play count.

3.2.6.3 - Upload Music Button

In ***Figure 50***, the copyFileToMusicFolder() and copyFile() methods allow a file to be taken in as a parameter and copied to the "*music*" directory:

```
    private void copyFileToMusicFolder(File file)
    {
        File dest = new File("music/" + file.getName());
        copyFile(file, dest);
        if (dest.exists()) //Tests
        {
            System.out.println("Uploaded: " + dest.getAbsolutePath());
        }
        else
        {
            System.out.println("Failed to upload: " + file.getAbsolutePath());
        }
    }

    private void copyFile(File source, File dest)
    {
        try (FileInputStream is = new FileInputStream(source); //Both streams close at same tim
            FileOutputStream os = new FileOutputStream(dest))
        {
            byte[] buffer = new byte[1024];
            int length;

            while ((length = is.read(buffer)) > 0) //Length = exact number of bytes to dest fil
            {
                os.write(buffer, 0, length);
            }
        }
        catch (IOException e) //Can't copy
        {
            e.printStackTrace();
        }
    }
```

Figure 50: Prerequisite methods for Figure 51 used to copy songs over to music directory in the Application

The copyFile() method gives the main copying functionality by creating a source and destination stream and then writing the file to the destination.

The copyFileToMusicFolder() method takes advantage of the copyFile() method's abilities by taking a file to be copied as a parameter and then setting "***music/+ file.getName()***" as the destination for the file.

Then the uploadMusicAction() method is bound to the "Upload Music" button on the Front-End so this method is invoked when the button is clicked:

```
@FXML
private void uploadMusicAction(ActionEvent event)
{
    FileChooser fileChooser = new FileChooser();

    // Set extension filter for .mp3 files and allow directories
    fileChooser.getExtensionFilters().add(new FileChooser.ExtensionFilter("MP3 files (*.mp3)", "*.mp3"));
    fileChooser.setTitle("Select Music Files or Directory");

    List<File> selectedFiles = fileChooser.showOpenMultipleDialog(null); // Enable multiple selection

    if (selectedFiles != null) //If file selected
    {
        for (File file : selectedFiles) //Every file in selected files
        {
            if (file.isDirectory()) //If Directory
            {
                File[] filesInDir = file.listFiles((dir, name) -> name.toLowerCase().endsWith(".mp3"));//E
                if (filesInDir != null) //If not empty
                {
                    for (File mp3File : filesInDir) //Every MP3 File in fileInDir
                    {
                        copyFileToMusicFolder(mp3File);//Copy them over to music folder
                    }
                }
            }
            else if (file.getName().toLowerCase().endsWith(".mp3")) //Selected is one MP3
            {
                copyFileToMusicFolder(file);//Copy over to music folder
            }
        }
    }
}
```

Figure 51: Upload Music Action linked to the Upload Music Button on the Front-End

The invoked method opens up the file directory[***3.1.3.4a***] by initialising a FileChooser Object, and then setting the extension to accept MP3 files only, the selected MP3 file will be copied to the music folder. If multiple files(or a directory) are selected then the files are copied one by one to the music folder through a "for loop". If a directory is embedded within the directory then it will copy every file within that embedded directory too.

3.2.6.4 - Scene Switch Buttons

a)Switching to the Dashboard (Main.FXML):

When the Dashboard button is clicked on the Front-End, ***Figure 52***'s switchToMain() method is invoked:

```
/Switch to Main.FXML
    public void switchToMain(ActionEvent event) throws IOException
    {
        fromPlaylists = false;
        fromLibrary = false;

        System.out.println("switchToMain");

        Parent root = FXMLLoader.load(getClass().getResource("Main.fxml"));//Load main.fxml
        stage = (Stage)((Node)event.getSource()).getScene().getWindow();//Current Stage from button click
        scene = new Scene(root);//New scene with root loaded from Main.FXML
        stage.setScene(scene);//Set new scene on current stage
        stage.show();//Show the main view

    }
```

Figure 52: Switch to the Dashboard (Main.FXML) scene

The context is first set to show that the scene is neither from the playlist nor from the library therefore they're both false. This will be used in the initialisation method **[3.2.6.1]** to invoke the populateFrequentlyPlayed() method.

The main.fxml file is loaded in ⇒ the current stage is set as the stage ⇒ the scene is set on the stage ⇒ the stage is shown. This process is how a developer would regularly switch a scene in JavaFX. The other scenes cover the same concept but the population of the table view and cells is done within the switch methods as will be seen in switchToLibrary() in the section below.

In ***Figure 53***, the populateFrequentlyPlayed() method, when invoked, populates the eight hboxs displayed in Main.FXML:

```
    private void populateFrequentlyPlayedSongs()
    {
        System.out.println("populateFrequentlyPlayedSongs one");//TEST

        //GlobalMediaPlayer.loadSongs(songData);//load songs into GlobalMediaPlayer
        GlobalMediaPlayer.loadFrequentlyPlayedList();//load the playcount data

        List<Song> topPlayedList = GlobalMediaPlayer.getTopFrequentlyPlayedSongs(8);//Returns list of frequently played songs


        System.out.println("topPlayedList: ");//TEST
        System.out.println("freqPlayedSongs = " + freqPlayedSongs);//TEST

        // Iterate over the list and update the UI to display the songs.
        for (int i = 0; i < topPlayedList.size(); i++)
        {//Bob the builder
            Song song = topPlayedList.get(i);

            HBox hBox = (HBox) freqPlayedSongs.getChildren().get(i);//Hbox index for the song
            hBox.setStyle("-fx-background-color: #397DFF;"); //same as colour as upload music button

            //Updates art,song title,artist & song duration within each hbox
            ImageView imageLabel = (ImageView) hBox.getChildren().get(0);
            imageLabel.setImage(song.getAlbumArt());

            Label titleLabel = (Label) hBox.getChildren().get(1);
            titleLabel.setStyle("-fx-text-fill: white;");
            titleLabel.setText(song.getTitle());

            Label artistLabel = (Label) hBox.getChildren().get(2);
            artistLabel.setStyle("-fx-text-fill: white;");
            artistLabel.setText(song.getArtist());

            Label durationLabel = (Label) hBox.getChildren().get(3);
            durationLabel.setStyle("-fx-text-fill: white;");
            durationLabel.setText(song.getDuration());


            //Playbutton function next to each song so they can be played
            ImageView playBtn = (ImageView) hBox.getChildren().get(4);
            int finalI = i;
            playBtn.setOnMouseClicked(new EventHandler<MouseEvent>() {
                @Override
                public void handle(MouseEvent event) {
                    songNumber = getNumberOf(topPlayedList.get(finalI));
                    updateMediaPlayer();//Plays song selected
                    updateSongDetails();
                }
            });

        }

    }
```

Figure 53: Populating the Frequently Played Songs Hboxs

```
//Populating the frequently played songs list:
    private void populateFrequentlyPlayedSongs()
    {
        System.out.println("populateFrequentlyPlayedSongs one");//TEST

        GlobalMediaPlayer.loadFrequentlyPlayedList();//load the playcount data

        List<Song> topPlayedList = GlobalMediaPlayer.getTopFrequentlyPlayedSongs(8);


        System.out.println("topPlayedList: ");//TEST
        System.out.println("freqPlayedSongs = " + freqPlayedSongs);//TEST

        // Iterate over the list and update the UI to display the songs.
        for (int i = 0; i < topPlayedList.size(); i++)
        {//Bob the builder
            Song song = topPlayedList.get(i);

            HBox hBox = (HBox) freqPlayedSongs.getChildren().get(i);//Hbox index for
            hBox.setStyle("-fx-background-color: #397DFF;"); //same as colour as uplo

            //Updates art,song title,artist & song duration within each hbox
            ImageView imageLabel = (ImageView) hBox.getChildren().get(0);
            imageLabel.setImage(song.getAlbumArt());

            Label titleLabel = (Label) hBox.getChildren().get(1);
            titleLabel.setStyle("-fx-text-fill: white;");
            titleLabel.setText(song.getTitle());

            Label artistLabel = (Label) hBox.getChildren().get(2);
            artistLabel.setStyle("-fx-text-fill: white;");
            artistLabel.setText(song.getArtist());

            Label durationLabel = (Label) hBox.getChildren().get(3);
            durationLabel.setStyle("-fx-text-fill: white;");
            durationLabel.setText(song.getDuration());


            //Playbuttton function next to each song so they can be played
            ImageView playBtn = (ImageView) hBox.getChildren().get(4);
            int finalI = i;
            playBtn.setOnMouseClicked(new EventHandler<MouseEvent>() {
                @Override
                public void handle(MouseEvent event) {
                    songNumber = getNumberOf(topPlayedList.get(finalI));
                    updateMediaPlayer();//Plays song selected
                    updateSongDetails();
                }
            });

        }

    }
    @FXML
```

The main notion of this method is to invoke the getTopFrequentlyPlayedSongs(8) method, the integer refers to the 8 hboxs in the Frequently Played List and this method returns a list of 8 songs ordered by play count by decreasing order.

It then goes through each frequently played song to add their details to each hbox child. These hbox children can be referred to like this :

- 0 - ImageView imageLabel - used to display song art in the frequently played list. However, this does not work at the moment and should be noted to be fixed in future work. The hypothesis behind it not functioning is that the image view in the song method is transient so avoids serialisation and then deserialisation into the songData variable, therefore it's not present.
- 1 - Label titleLabel - Displays the title of the song using the ***Song*** class's getter methods
- 2 - Label artistLabel - Displays the artist of the song using the same getter methods
- 3 - Label durationLabel - Displays the duration of the song
- 4 - ImageView playBtn - the image view has a play button set upon it, when this image is clicked the song number of the song in the hbox is extracted using the getNumberOf() method then updating the Media Player and song details. The updateMediaPlayer() method ***[3.2.6.1]*** starts a song instance with this selected song and then plays it. The updateSongDetails() method is used thereafter to, consequently, update the labels.

b)Switching to the Library (Library.FXML):

Clicking the Library button will invoke the switchToLibrary() Method in ***Figure 54***:

```java
//Switch to Library.FXML
    public void switchToLibrary(ActionEvent event) throws IOException
    {
        fromLibrary = true;//Context for initialisation
        fromPlaylists = false;

        System.out.println("switchToLibrary");

        FXMLLoader loader = new FXMLLoader(getClass().getResource("Library.fxml"));
        Parent root = loader.load();
        SceneController sceneController = loader.getController();
```

Figure 54: Switch to the Library (Library.FXML) scene

It works with the same premise as switchToMain(), the context is assigned at the start of the method so fromLibrary is set to true. However, it creates an instance of FXMLLoaded to extract the controller instance using the getController method(), this controller instance is used to set up the table for the library.

Figure 55 shows the Table-Getter methods from the ***SceneController*** class:

```java
//Table Getters:
    public TableView<Song> getTableView() {
        return tableView;
    }
    public TableView<Song> getTableView2() {
        return tableView2;
    }
    public TableColumn<Song, String> getSongTable() {
        return songTable;
    }
    public TableColumn<Song, String> getArtistTable() {
        return artistTable;
    }
    public TableColumn<Song, String> getAlbumTable() {
        return albumTable;
    }
    public TableColumn<Song, String> getYearTable() {
        return yearTable;
    }
    public TableColumn<Song, String> getActionTC() {
        return actionTC;
    }
    public TableColumn<Song, String> getActionTC2() {
        return actionTC2;
    }
    public VBox getFreqPlayedSongs() {
        return freqPlayedSongs;
    }
    public FlowPane getPlaylists_container() {
        return playlists_container;
    }

    public Label getSelectedPL() {
        return selectedPL;
    }
```

Figure 55: Getter Methods for the Tables

These getters are used so all the Tableview cells can be initialised:

```java
        sceneController.getSongTable().setCellValueFactory(new PropertyValueFactory<>("title"));
        sceneController.getArtistTable().setCellValueFactory(new PropertyValueFactory<>("artist"));
        sceneController.getAlbumTable().setCellValueFactory(new PropertyValueFactory<>("album"));
        sceneController.getYearTable().setCellValueFactory(new PropertyValueFactory<>("year"));

        // Cell for adding to the playlist
        sceneController.getActionTC().setCellFactory(new Callback<TableColumn<Song, String>, TableCell<Song, String>>()
        {
            @Override
            public TableCell<Song, String> call(TableColumn<Song, String> param)
            {
                return new TableCell<Song, String>()
                {
                    final Button btn = new Button("+");
                    {
                        btn.setStyle("-fx-background-color: green; -fx-text-fill: white; -fx-font-size: 20px; -fx-padding: 0 10 0 10; -fx-margin: 0;");
                        btn.setOnAction(event -> {
                            Song song = getTableView().getItems().get(getIndex());//Get index of song to add to playlist
                            System.out.println("Button clicked for song: " + song.getTitle());
                            showAddToPlaylistDialog(song);
                        });
```

Figure 56: Initialisation of the Tableview Cells using methods in Figure 55

This comes with the inclusion of ActionTC which is the “Add to Playlist” button ***[3.1.3.2]***. When this button is clicked the table view index for that row is assigned to song value, stating the song to be added to the playlist. Then the showAddToPlaylistDialog() method is invoked, showing the user the Playlist Dialog Screen ***[3.1.3.4b][3.2.6.5]*** where the user will then choose which playlist to send the Song to.

In ***Figure 57***, the updateItem() method is used to check if the cell in the table is empty:

```
            @Override
            public void updateItem(String item, boolean empty) {
                super.updateItem(item, empty);
                if (empty)
                {
                    setGraphic(null);
                    setText(null);
                }
                else
                {
                    setGraphic(btn);
                    setText(null);
                }
            }
        };
    }
});
```

Figure 57: Update the Cell to add an Add to Playlist buttons used in SwitchToPlaylist/Library

If the cell is empty, the application will make sure no graphics are set to it. If there is a cell present then the *'btn'* variable which was defined in ***Figure 56*** will be used to make a new "Add to Playlist" button at the end of each row.

The songData is then extracted and then set upon the table view:

```
        //Update table view with songData
        songData = sceneController.songData;
        sceneController.getTableView().setItems(songData);

        if (!songData.isEmpty()) {
            Song playingSong = songData.get(songNumber);
            sceneController.getTableView().getSelectionModel().select(playingSo
        }

        System.out.println(songNumber);

        //Set and show new  scene:
        stage = (Stage)((Node)event.getSource()).getScene().getWindow();
        scene = new Scene(root);
        stage.setScene(scene);
        stage.show();
    }
```

Figure 58: Setting Songs onto the TableView

The "if" statement, gets the currently playing song and then highlights it in the table view. The rest of the method is identical to how switchToMain() operates to show the scene.

c)Switching to the Playlists (Playlist.FXML):

In ***Figure 59***, the switchToPlaylist() method which is invoked by the Playlist button, works the same as the two switch methods above, however, in addition, it requires the initialisation of another cell ActionTC2:

```
sceneController.getActionTC2().setCellFactory(new Callback<TableColumn<Song, String>, TableCell<Song, String>>() {
    @Override
    public TableCell<Song, String> call(TableColumn<Song, String> param) {
        return new TableCell<Song, String>() {
            final Button btn = new Button("-");

            {
                btn.setStyle("-fx-background-color: red; -fx-text-fill: white; -fx-font-size: 20px; -fx-padding: 0 10 0 10; -fx-margin: 0;");
                btn.setOnAction(event -> {
                    Song song = getTableView().getItems().get(getIndex());
                    try {
                        deleteFromPlayList(song, sceneController, event);
                    } catch (IOException e) {
                        throw new RuntimeException(e);
                    }
                });
            }

            @Override
            public void updateItem(String item, boolean empty) {
                super.updateItem(item, empty);
                if (empty) {
                    setGraphic(null);
                    setText(null);
                } else {
                    setGraphic(btn);
                    setText(null);
                }
            }
        };
    }
});
```

Figure 59: Action added to remove song from a playlist in switchToPlaylist() method

ActionTC2 is the "Remove" button ***[3.1.3.3]***, the initialisation of this button works with the same concept as ActionTC but it uses the deleteFromPlaylist() method instead to remove the song from the playlist.***[3.2.6.5]***

The context of this scene is also set up like this:

```
fromLibrary = false;
fromPlaylist = true;
```

This invokes the populatePlaylistButtons() method in the initialisation method ***[3.2.6.1]*.**

3.2.6.5 - Playlist Functionality

In ***Figure 60***, the populatePlaylistButtons() method initialises all the playlist buttons and then starts playing the first playlist automatically:

```
private void populatePlaylistButtons(SceneController sceneController)
{
    getPlaylists_container().getChildren().clear();

    if (playlists != null) //If playlists exist
    {
        for (String playlistName : playlists.keySet()) //for each playlist name
        {
            Button playlistButton = new Button(playlistName);//Create new button with playlist
            playlistButton.setStyle("-fx-background-color:  #397DFF; -fx-text-fill: white;");
            playlistButton.setOnAction(event -> {
                // Selecting the playlist
                System.out.println("Selected playlist: " + playlistName);
                viewSongsOf(sceneController, playlists.get(playlistName));
                selectedPL.setText(playlistName);
            });

            playlists_container.getChildren().add(playlistButton);// Add the newly created butt
        }
        // Automatically start the first playlist button if exists
        if(!playlists_container.getChildren().isEmpty())
        {
            Button firstButtonPlayList = (Button) playlists_container.getChildren().get(0);

            if(firstButtonPlayList != null)
            {
                firstButtonPlayList.fire();
            }
        }

    }
}
```

Figure 60: Populate the Playlist Buttons for each Playlist

This method checks if playlists exist and for each playlist creates a new button within the FlowPane container ***[3.1.3.3]***. When a playlist button is clicked the set action event invokes the viewSongsOf() method which populates the song within the playlist. The label text above the TableView is set to show the name of the currently playing playlist.

In ***Figure 61***, the viewSongsOf() method populates the table view with the selected songs in a subset within the playlist:

```
/Display songs within a playlist
   private void viewSongsOf(SceneController sceneController, List<Song> songs)
   {
       if(!songs.isEmpty()) //If playlist isn't empty
       {
           playListData.setAll(songs);//set pldata to selected pl
           sceneController.getTableView2().setItems(playListData);
           sceneController.getTableView2().getSelectionModel().selectFirst();//Select first
           songNumber = getSongNumberOf(tableView2.getSelectionModel().getSelectedItem());//
           updateMediaPlayer();
           updateSongDetails();
           //GlobalMediaPlayer.pause();//Player always plays after update so pause
       }
       else
       {
           playlists.clear();
           sceneController.getTableView2().setItems(playListData);
           GlobalMediaPlayer.pause();
       }
   }
```

Figure 61: View songs within the Playlist (Subset of the Original Table)

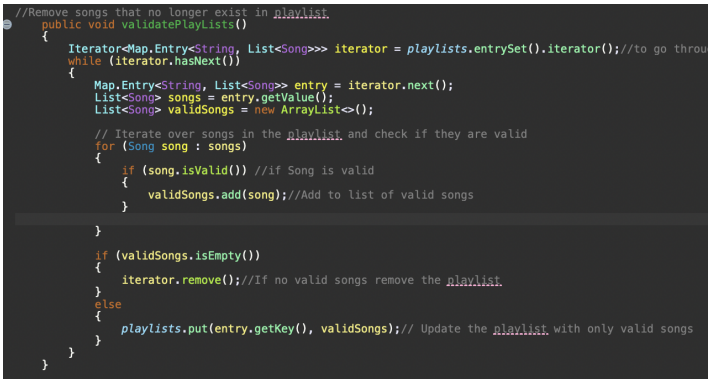
The thesis behind this method is that it takes the subset of songs and then displays them in the TableView. The first song in this tableview is selected and its index is set as the current song number. The updateMediaPlayer() method starts playing the currently selected song number which is the first song of the Playlist. Furthermore, when the scene is switched to the playlists the first song of the latest playlist will start playing automatically. If the playlists are empty, it clears all playlists and then clears and resets the Tableview.

The playlist is loaded and saved with the same premises as the ***GlobalMediaPlayer*** class in Section ***3.2.5.1***. The playlist data is serialised into “playlists.ser” using the savePlaylists() method so that the playlists are kept persistent. Then when the application is run again the loadPlaylists() method is run so that “playlists.ser” is deserialised and the data reassigned to the playlists variable:

```
//The serialisable file "playlists.ser" is deserialised and contains playlist data, persistently
    public Map<String, List<Song>> loadPlaylists()
    {
        Map<String, List<Song>> playlists = null;
        try (FileInputStream fileIn = new FileInputStream("playlists.ser");
             ObjectInputStream objectIn = new ObjectInputStream(fileIn))
        {
            playlists = (Map<String, List<Song>>) objectIn.readObject();
        }
        catch (IOException | ClassNotFoundException e) {
            //e.printStackTrace();
            System.out.println("playlists file is not found");
        }
        return playlists;
    }

//Takes playlist data serialises it into playlists.ser so that it is saved for next run
    private void savePlaylists()
    {
        try (ObjectOutputStream oos = new ObjectOutputStream(new FileOutputStream("playlists.ser")))
        {
            oos.writeObject(playlists);
            System.out.println("Playlists saved successfully.");
        }
        catch (IOException e)
        {
            e.printStackTrace();
            System.out.println("Error saving playlists: " + e.getMessage());
        }
    }
```

Figure 62: Deserializing and Serialising “Playlist.Ser” for Persistent Data

The concept is the same as in Section ***3.2.5.1***: the savePlaylists() method turns the playlists data into a byte stream to save into the serialised file like the saveFrequentlyPlayedList() method does, the loadPlaylists() method works a lot simpler than loadFrequentlyPlayedList() as it doesn’t implement an iterator, it’s process only requires deserialising the file. This is because the playlists are validated in the validatePlaylists() method instead:



```
//Remove songs that no longer exist in playlist
    public void validatePlayLists()
    {
        Iterator<Map.Entry<String, List<Song>>> iterator = playlists.entrySet().iterator();//to go throu
        while (iterator.hasNext())
        {
            Map.Entry<String, List<Song>> entry = iterator.next();
            List<Song> songs = entry.getValue();
            List<Song> validSongs = new ArrayList<>();

            // Iterate over songs in the playlist and check if they are valid
            for (Song song : songs)
            {
                if (song.isValid()) //if Song is valid
                {
                    validSongs.add(song);//Add to list of valid songs
                }

            }

            if (validSongs.isEmpty())
            {
                iterator.remove();//If no valid songs remove the playlist
            }
            else
            {
                playlists.put(entry.getKey(), validSongs);// Update the playlist with only valid songs
            }
        }
    }
```

Figure 63: Check if songs still exist when loading playlists on startup

This method uses the same concept as the loadFrequentlyPlayedList() method[***3.2.5.1***], it implements an iterator to check whether each song still exists when the application is loaded. It takes the songs that still exist within a playlist and puts them in an ArrayList, once it’s gone through all the songs in the playlist it appends all the songs back to the playlist apart from ones which were removed or don’t exist. If the list of valid songs is empty the playlist is removed entirely. This method is invoked every time a scene is initialised.

ActionTC - Adding Songs To Playlists (Used in switchToLibrary() & switchToPlaylist())

In ***Figure 64***, the showAddToPlaylistDialog() is invoked when the “add to playlist” actionTC buttons are clicked:

```
//Add to Playlist Window
    private void showAddToPlaylistDialog(Song song)
    {
        Stage dialogStage = new Stage();
        dialogStage.initModality(Modality.APPLICATION_MODAL);//Block interaction with main window until
        dialogStage.setTitle("Add Song to Playlist");

        ComboBox<String> playlistComboBox = new ComboBox<>();

        ObservableList<String> playlistNames = FXCollections.observableArrayList(playlists.keySet());
        playlistComboBox.setItems(playlistNames);//Existing playlists

        TextField newPlaylistTextField = new TextField();//User Input
        newPlaylistTextField.setPromptText("Enter new playlist name");

        Button addButton = new Button("Add");
        addButton.setOnAction(event -> {
            String selectedPlaylist = playlistComboBox.getSelectionModel().getSelectedItem();
            String newPlaylist = newPlaylistTextField.getText().trim();

            if (selectedPlaylist != null || !newPlaylist.isEmpty())
            {
                String playlistName = newPlaylist.isEmpty() ? selectedPlaylist : newPlaylist;
                System.out.println("Adding song to playlist: " + playlistName);

                // Get the playlist from the map or create a new one if it doesn't exist
                List<Song> playlist = playlists.getOrDefault(playlistName, new ArrayList<>());
                // Add the song to the playlist
                playlist.add(song);
                // Update the map with the modified playlist
                playlists.put(playlistName, playlist);

                // Save then close:
                savePlaylists();
                dialogStage.close();
            }
        });

        //UI components in a VBox:
        VBox vBox = new VBox(10);
        vBox.setPadding(new Insets(10));

        Label playlistLabel = new Label("Select Playlist:");
        HBox playlistBox = new HBox(10);
        playlistBox.getChildren().addAll(playlistLabel, playlistComboBox);

        vBox.getChildren().addAll(playlistBox, newPlaylistTextField, addButton);

        Scene dialogScene = new Scene(vBox);
        dialogStage.setWidth(300);
        dialogStage.setScene(dialogScene);
        dialogStage.showAndWait();
    }
```

Figure 64: Dialog Box for adding a song to a playlist, design can be seen in Figure 19

Modality:

The method implements a dialogue stage, which blocks all interaction with the main window until the dialogue box is closed. This is done through modality: there are different types of modality for this application we used *"Application Modality"*- which blocks interaction with any application window; but there is also *"None"* - the user can interact with every window; & *"Window Modality"* - blocks interaction with the owner window[***19***] (useful with applications with many different windows but because RetroSonic only has one window it ends up having the same functionality as Application Modality).

Playlist Selection:

The ComboBox is initialised to show the existing playlists, allowing the user to select any one of these playlists to add to.

The ObservableList holds the keys of the playlist map (which contains playlist names as keys and lists of songs as values) and then populates the ComboBox

The TextField allows users to enter a new playlist name. It has placeholder text "Enter new playlist name" to guide users.

The Button labelled "*Add*" is set up with an event handler for its action event. When clicked, it performs several functions:

- It checks if a playlist is selected from the ComboBox or if a new playlist name is entered in the TextField
- It determines which playlist name to use - if the new playlist TextField is empty use the selected playlist name, if not use the new playlist name
- It fetches the playlist from the playlist map using the chosen name or initialises a new list if the playlist does not exist.
- It adds the song to the specified playlist.
- It updates the playlist map with the modified playlist list.

UI Layout [***3.1.3.4b***]

The VBox layout is used to arrange the UI components vertically with a spacing of 10 pixels. A Label and the ComboBox are wrapped together in an HBox for horizontal arrangement. These components are added to the VBox, which also includes the TextField and the Button.

Scene and Window Setup

The VBox is set as the root node of a new Scene, which is then set on the dialog stage.

dialogStage.showAndWait() is called to display the window and block any further user action on other application windows until this dialog is closed.

ActionTC2 - Used for removing songs from a playlist (Used in switchToPlaylist())

In ***Figure 65***, the deleteFromPlaylist() is invoked when the "Remove" actionTC2 button is clicked:

```
private void deleteFromPlayList(Song song, SceneController sceneController, ActionEvent event) throws IOException {
    String plName = sceneController.getSelectedPL().getText();//Current playlist name
    TableView<Song> tv = sceneController.getTableView2();// Table view for songs in the pl
    List<Song> pl = playlists.get(plName);//List of songs in the pl
    if(pl.size() == 1) //If playlist = 1 song
    {
        playlists.remove(plName);//Delete this playlist
        GlobalMediaPlayer.pause();
        //Find the button and delete it from the UI:
        Node node = null;
        for (Node child : sceneController.getPlaylists_container().getChildren())
        {
            if(((Button) child).getText() == plName)
            {
                node = child;
                break;
            }
        }
        sceneController.getPlaylists_container().getChildren().remove(node);
        //Update Changes and Switch to another existing playlist
        savePlaylists();
        switchToPlaylist(event);
        GlobalMediaPlayer.pause();

    }
    else //If playlist contains more than one song just remove the song
    {
        pl.remove(song);
        playlists.put(plName, pl);
    }
    savePlaylists();
    System.out.println(song.getTitle() + " is deleted from " + plName);
//Update table view:
    if(tv.getSelectionModel().getSelectedItem() != null && tv.getSelectionModel().getSelectedItem().equals(song))   // Check if c
    {
        int index = tv.getSelectionModel().getSelectedIndex();//index of removed song
        // Determine new index. If the removed song was not the last one, move to the next song;
        // otherwise, wrap around and select the first song in the playlist.
        if (index < pl.size() - 1)
        {
            index++;
        } else
        {
            index = 0;
        }
        tv.getSelectionModel().select(index);//Select song in tableview

        pl = playlists.get(plName);

        songNumber = getSongNumberOf(pl.get(index));//Update songNumber to reflect newly selected song
        updateMediaPlayer();//Play new song
    }

    // Update the TableView's items to reflect the current state of the playlist.
    if (pl != null)
    {
      // Check if playlist exists (it should not be null after deletion unless it was the only playlist and got removed)
        playListData.setAll(pl);// Update playlistData that backs the TableView with the modified playlist.
        tv.setItems(playListData);// Set the modified list of songs as the new item list for the TableView.
    }
}
```

Figure 65: Deleting a song from the Playlist activated by ActionTC2 "Remove" in Figure 59

This method begins by identifying the current playlist and the song to be removed. It fetches the playlist name and the respective TableView containing the songs from the ***SceneController***, which manages the user interface interactions.

Playlist and Song Management

The method handles different scenarios based on the playlist's content:

- **Single Song Playlists:** If the playlist contains only one song, the entire playlist is removed from the application's playlist map. This also involves updating the user interface to reflect the removal and handling of the deletion of UI elements like buttons.
- **Multiple Song Playlists:** If more than one song exists, only the selected song is removed from the list. The playlist map is then updated to reflect this change.

UI and Playback Updates

Upon successfully updating the playlist data:

- **Table View Update -** If the deleted song was the currently selected song in the UI, the selection is moved to the next song, or loops back to the first song if the deleted song was the last in the list.
- **Playback Adjustment -** If necessary, the media player's state is updated; either pausing playback if the playlist is removed or starting the next song.

Persistent Data Management

After modifying the playlist, the savePlaylists() method is called to serialise the updated playlist map to persistent storage, ensuring that changes persist across application sessions. [***Figure 65***]

Final Operations:

The method concludes by ensuring that any changes are not only reflected in the UI but also in the back-end data, maintaining integrity and consistency of the application's state.

3.2.6.6 - Editing Metadata

In ***Figure 66***, the showEditSongMetadataDialog() method is invoked when the settings button is clicked[*3.1*]:

```
    private void showEditSongMetadataDialog() {
        Song selectedSong = GlobalMediaPlayer.getSong(songNumber);

        if (selectedSong == null) {
            System.out.println("No song selected.");
            return;
        }

        Stage dialogStage = new Stage();
        dialogStage.initModality(Modality.APPLICATION_MODAL);
        dialogStage.setTitle("Edit Song Metadata");

        GridPane grid = new GridPane();
        grid.setHgap(10);
        grid.setVgap(10);
        grid.setPadding(new Insets(20, 150, 10, 10));

        TextField titleField = new TextField(selectedSong.getTitle());
        TextField artistField = new TextField(selectedSong.getArtist());
        TextField albumField = new TextField(selectedSong.getAlbum());
        TextField yearField = new TextField(selectedSong.getYear());

        grid.add(new Label("Title:"), 0, 0);
        grid.add(titleField, 3, 0);
        grid.add(new Label("Artist:"), 0, 1);
        grid.add(artistField, 3, 1);
        grid.add(new Label("Album:"), 0, 2);
        grid.add(albumField, 3, 2);
        grid.add(new Label("Year:"), 0, 3);
        grid.add(yearField, 3, 3);

        Button doneButton = new Button("Done");
        doneButton.setOnAction(event -> {
            // Apply changes and close dialog
            try {
                MP3TagWriter.setTitle(selectedSong, titleField.getText());
            } catch (NotSupportedException | IOException e) {

                System.out.println("Song contains Obselete Frames, Cannot be Saved!");
            }
            try {
                MP3TagWriter.setArtist(selectedSong, artistField.getText());
            } catch (NotSupportedException | IOException e) {
                System.out.println("Song contains Obselete Frames, Cannot be Saved!");
            }
            try {
                MP3TagWriter.setAlbum(selectedSong, albumField.getText());
            } catch (NotSupportedException | IOException e) {
                System.out.println("Song contains Obselete Frames, Cannot be Saved!");
            }
            try {
                MP3TagWriter.setYear(selectedSong, yearField.getText());
            } catch (NotSupportedException | IOException e) {
                System.out.println("Song contains Obselete Frames, Cannot be Saved!");
            }
            dialogStage.close();
        });

        grid.add(doneButton, 1, 4);

        Scene dialogScene = new Scene(grid, 500, 250);
        dialogStage.setScene(dialogScene);
        dialogStage.showAndWait();
    }
}
```

Figure 66: Dialogue Box for Editing the Song's Metadata, seen in Figure 20

This method works in-hand with the ***MP3TagWriter*** class*[3.2.3]* which handles all the editing of metadata in the back-end. This method provides the dialogue screen with four text fields displaying the current title, artist, album & year tags which can be edited to provide the ***MP3TagWriter*** class with fields to edit.*[3.1.3.4c]*

Modality

This method sets up a modal dialogue window, which freezes all other user interactions with the application until the metadata editing is complete. This is accomplished through Modality.APPLICATION_MODAL, which is used in the showAddToPlaylistDialog() in ***Figure 64***. The same logic applies here.

UI Layout and User Input

A GridPane layout is used to organise labels and text fields linearly for editing the song's title, artist, album, and year. These fields are pre-populated with the current metadata values of the selected song, allowing users to see and modify the existing information easily.

The grid is structured with consistent gaps and padding to ensure the dialogue is visually appealing and easy to use. Each metadata attribute (title, artist, album, year) is paired with a corresponding TextField where users can input new values.

Applying Changes:

The '*Done*' button at the bottom of the dialogue triggers the update process. This button is wired to an event handler that attempts to write the updated metadata back to the song file using the ***MP3TagWriter*** class methods. If the metadata contains obsolete frames that cannot be saved, it catches exceptions.

This method is used in case of this error in ***Figure 67***:

```
com.mpatric.mp3agic.NotSupportedException: Packing Obselete frames is not supported
        at com.mpatric.mp3agic.ID3v2ObseleteFrame.packFrame(ID3v2ObseleteFrame.java:32)
        at com.mpatric.mp3agic.ID3v2Frame.toBytes(ID3v2Frame.java:83)
        at com.mpatric.mp3agic.AbstractID3v2Tag.packSpecifiedFrames(AbstractID3v2Tag.java:275)
        at com.mpatric.mp3agic.AbstractID3v2Tag.packFrames(AbstractID3v2Tag.java:261)
        at com.mpatric.mp3agic.AbstractID3v2Tag.packTag(AbstractID3v2Tag.java:227)
        at com.mpatric.mp3agic.AbstractID3v2Tag.toBytes(AbstractID3v2Tag.java:218)
        at com.mpatric.mp3agic.Mp3File.save(Mp3File.java:450)
        at application.MP3TagWriter.saveMp3File(MP3TagWriter.java:69)
        at application.MP3TagWriter.setYear(MP3TagWriter.java:52)
        at application.SceneController.lambda$3(SceneController.java:1085)
```

Figure 67: Error for obsolete frames of songs

This error occurs only with certain MP3 files, usually, those which haven't been formatted correctly or contain unsupported tags. In these cases like these, this catch exception is used.

3.2.7 - UML-Design

This UML design was created after the application was created. Thus, since doing this project the importance of a good back-end design was reinstated in my head due to seeing how it affects the development time of a project.

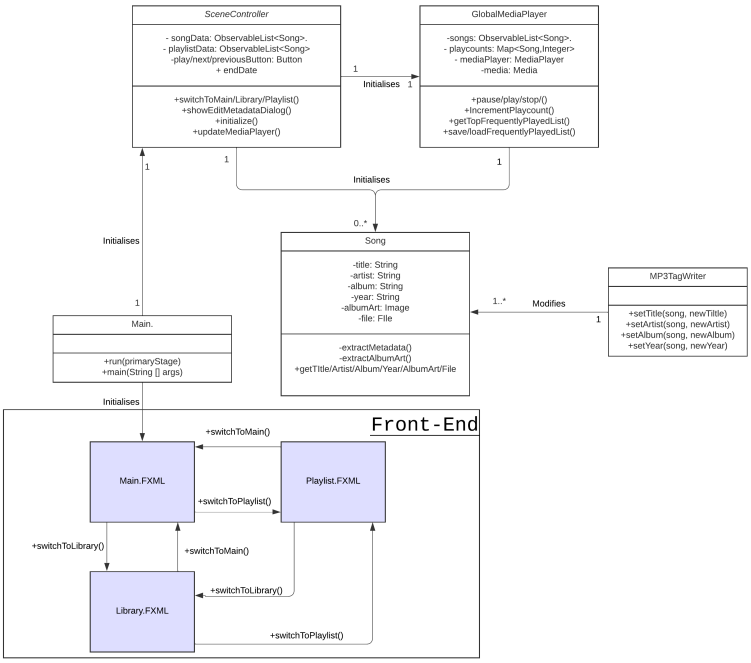


Figure 68: UML diagram for the Music Player (5 Java Files, 3 FXML Files)

In ***Figure 68***, the UML Diagram gives a comprehensive depiction of how the application works:

- The ***Main*** class is the main entry point for the JavaFX application, which initialises the primary stage and loads the initial scene and ***Scenecontroller*** class.
- The ***Scenecontroller*** class initialises the ***Song*** class and the ***GlobalMediaPlayer*** class.
- The ***SceneController*** and the ***GlobalMediaPlayer*** have a **one→one relationship**, meaning only one of each class can be initialised at any time. The GlobalMediaPlayer also initialises the Song class.
- ***SceneController*** & ***GlobalMediaPlayer*** initialises a **one → zero to many** (1→0..*) relationship with the ***Song*** class meaning that the ***SceneController*** & ***GlobalMediaPlayer*** can have no songs, one song or many songs.
- Conversely, the ***MP3TagWriter*** class modifies the ***Song*** class with a **one → one to many** (1→1..*) relationship due to the class needing at least one song to modify, to get initialised.
- The UML diagram also shows how the front end uses the switch methods[***3.2.6.4***] to switch between the FXML file scenes.

3.2.7.1 - Evaluating The Back-End Design

The ***SceneController*** is used as the controller for all three fxml files ***[3.1]***. This is a SOLID Principle design flaw destined for this application due to a lack of experience in building JavaFX applications. Instead, using three controllers, one per scene, would have helped the application's implementation process tremendously by making the logic separate for each part of the application. This error in judgement, caused bugs to be hard to find due to a lack of modularity, having to look through lots of code to find errors. I remember attending ***COMP228-App Development*** and using the approach of one controller on each scene if the application was particularly complex like RetroSonic.

This approach of one controller per scene would lead to a single responsibility for each controller; main.fxml controller would focus on populating frequently played songs, while library.fxml controller would focus on populating the library & playlist.fxml's controller would focus on populating playlists. Resulting in code that abides by the SOLID principle of Single Responsibility taught in ***COMP319-Software Engineering 2***.

Currently, the controller has all three responsibilities but that's not to say it doesn't also have its benefits, the fxml files, due to being built upon on another's templates ***[3.1]*** share a lot of similar components - sidebar buttons, multimedia buttons, songs art & labels. If the application would abide by SOLID principles it would lead to lots of redundancy. For example, all three controllers have a play/pause, next or previous button, this means all three controllers would have to handle the scene's media control buttons using the same code.

Albeit, this code should have been shortened by handling most of the logic in the ***GlobalMediaPlayer*** class so that each Scenecontroller only has to use methods like this:

```
public void playMedia()
{
GlobalMediaPlayer.play()
}
```

The same applies for the Settings Button[***3.1.3.4c***]; the logic should be moved to the ***MP3TagWriter*** class so that if the controllers were separated, the dialogue box[***3.1.3.4c***] from the showEditMetaDataDialog() method[***3.2.7***] doesn't have to get implemented three times across each controller instead this can be bound to the settings button:

```
public void showEditMetadataDialog()
{
MP3TagWriter.showSettingsDialogBox()
}
```

Overall, this would shorten the amount of redundant code, if three controllers were to be used.

4 - Testing & Evaluation

4.1 - Log Testing

Most of the testing in this project was done through small print statements; through the console to check when methods are being invoked or if they're being invoked at all. For Example:

Class	Method & Log	Why it's used
GlobalMediaPlayer	pause() - System.out.print("pause button clicked")	Checking if fx:id is connected properly
SceneController	initialize() - System.out.print(songNumber);	Check what the songNumber is when switching scenes and initialising, was useful when having errors with the correct song showing up when switching scenes
SceneController	beginTimer() - System.out.println("Test");	Check if the song progress bar is being initialised. Was having a problem with the

		progress bar appearing so initialised this to see if this method was being invoked

Console logs like these are planted throughout the ***SceneController*** to express variables at certain points of the applications to make sure the specific parts application are functioning and being invoked correctly.

4.2 - Testing Metadata Editing Functionality Works in Other Libraries

With a clean run of the application, I will upload 2 songs to the library, which require tag manipulation.

Figure 69 shows the pre-edited songs in an iTunes library:

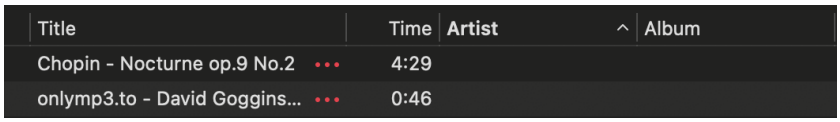


Figure 69: Original Song File within iTunes Library

Figure 70 shows the pre-edited songs in the RetroSonic library:

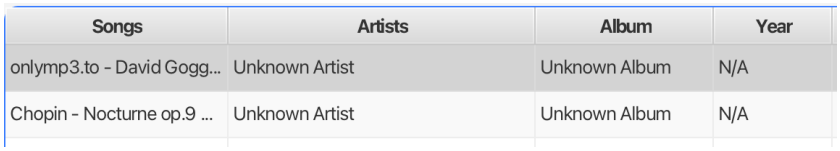


Figure 70: Original Song File within RetroSonic Library

These two songs will be selected and the Settings button will be clicked to reveal the edit metadata dialog box:

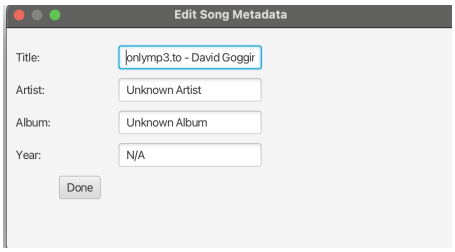


Figure 71: Song 1's Metadata Tags

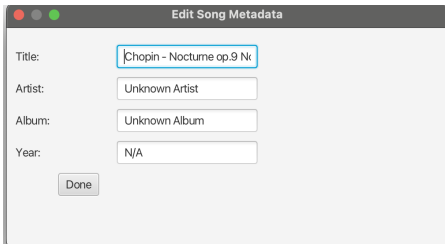


Figure 72: Song 2's Metadata Tags

The metadata tags of these songs will now be adjusted to the correct tags to whatever the user chooses to be appropriate:

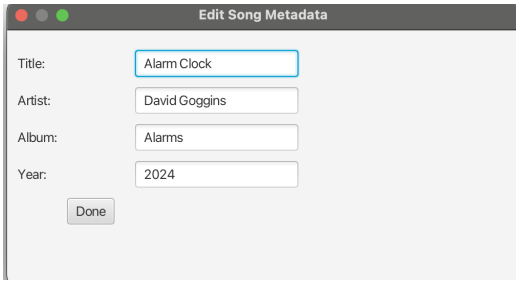


Figure 73: Editing Song 1's Tags

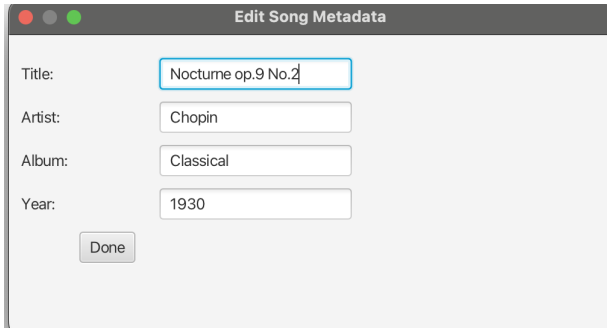


Figure 74: Editing Song 2's Tags

When the "Done" button is clicked, the process of updating the metadata is instantaneous and the changes to the song file are made directly without the need for the user to wait ***Figure 75*** now shows the songs with the edited tags in the

RetroSonic library:

Songs	Artists	Album	Year
Alarm Clock	David Goggins	Alarms	2024
Nocturne op.9 No.2	Chopin	Classical	1930

Figure 75: Modified Songs in RetroSonic Library

When we export the songs out of the application, the file's tags are permanently edited so if we view these songs now in the iTunes library again:

Title	Time	Artist	Album
Nocturne op.9 No.2	4:29	Chopin	Classical
Alarm Clock	0:46	David Goggins	Alarms

Figure 76: Modified Songs in iTunes Library

As expressed in ***Figure 76***, the metadata tag writing feature of this application works correctly, making permanent tag changes onto songs, not exclusive to the RetroSonic Library[***Figure 75***] but also to any external music player libraries the user wants to export their songs to.

5- Project Ethics

The primary ethical concern with this project is the potential for users to distribute copyrighted music with corrected metadata. However, it's important to consider that the inclusion of a Media Player in the application is very likely to discourage this behaviour. Users seeking solely to edit tags to distribute pirated music would rather opt for a dedicated, lightweight music tag editor rather than a heavier media player application like RetroSonic, which in addition offers metadata editing capabilities. Therefore, having the Media Player makes it more likely that the application will be used to organise and play personal music collections rather than to distribute pirated content.

Check Appendix A1 to see how the survey was formatted by anonymising results and disallowing multiple responses so the survey was fair.

6- Conclusion & Future Work

To conclude, the RetroSonic Music Player project represents a significant step forward in the personal management and playback of MP3 files, offering a user-friendly interface for song playback and metadata editing. By leveraging the powerful JavaFX framework and integrating the MP3agic library for metadata manipulation, this project successfully delivers a standalone music management solution that caters to the specific needs of users who require a more hands-on approach to their music collections.

Throughout the development process, from requirement analysis to implementation and testing, the project adhered to a rigorous design and development methodology. The user-centric design, highlighted by the Simplified User Interface (SUI), ensures that even individuals with minimal technological expertise can navigate and utilise the RetroSonic Music Player with ease. The application's ability to edit and manage metadata directly within the UI adds a layer of functionality that sets it apart from traditional media players like iTunes and Windows Media Player, which separate media playback and metadata management into distinct functionalities.

However, the project is not without its areas for improvement and future development:

Refactoring - I have mentioned many times throughout this report how I would refactor the code to improve upon the original. **For example:** As explained in the ***Evaluating Scenecontroller Design*** Section ***3.2.7.1***, the current implementation utilises a single controller for multiple views, which, while functional, complicates the codebase and deviates from SOLID practices in software architecture. Future iterations should aim to refactor the code into a more modular approach, using separate controllers for different functionalities to enhance maintainability and scalability.

Enhanced Metadata Support - Expanding the range of editable metadata fields and supporting more file formats would make RetroSonic a more versatile tool. MP3agic has many more built-in setter methods, which can edit fields such as song art & genre. For example, here's another method that could be added to edit the Genre tag(the same can be done for other metadata tags):

```
public static void setGenre(Song song, String newGenre) throws NotSupportedException, IOExceptio
        try
        {
            Mp3File mp3file = new Mp3File(song.getFilePath());
            ID3v2 tag = getOrCreateId3v2Tag(mp3file);
            tag.setGenre(newYear);
            saveMp3File(mp3file, song.getFilePath(), "temp_genre.mp3");  // Using a temporary fi
        }
```

Support For More Types of Audio Files - As mentioned in the ***Introduction*** in Chapter *1*. The JavaFX's API is extensive, especially for its MediaPlayer which can support formats other than MP3 files such as .wav or .aifff. Implementing them would be as easy as removing the barrier on the Upload Music Button[***Figure 51***][***3.2.6.3***] only accepting MP3 Files by changing the extension filter to include additional file types. However, this would require changing from the MP3agic library to the JaudioTagger library which has support for tag manipulation of more file types[***15***], which would require changing ***Song.java*** and ***MP3TagWriter.Java.*** It was too time-consuming leading up to the deadline of the application which is why it was not included.

Support for Video Playback - Additionally to the support for more audio files mentioned above, the MediaPlayer API also includes support for all video formats. In the future work of this application, I would include a feature to allow music videos to be played within the music player. This work wouldn't be too extensive and would require using the knowledge of everything I have learnt to build this application. To implement this feature, I would change the extension filter to include video format as mentioned in the section above. Then I would edit the ***GlobalMediaPlayer*** class to include an if statement to check if the song is of video format. If it is a video it will pop up a Popup Window using the modality-"*None*" mentioned in Section ***3.2.6.5*** under ***Modality***. This would allow the user to be able to access the main window so that the user could still change the song if necessary or access the metadata of the video.

User Feedback & Bugs Fixes - Continued user testing and feedback are essential to refine the user interface and functionality. Implementing the feedback given about the application could provide ongoing insights into user needs and preferences, driving iterative improvements.

Mobile Compatibility - Extending the application to mobile platforms could significantly increase its accessibility and utility, allowing users to manage their music libraries on the go this would require scalable cloud servers to hold individual libraries and playlists. To accomplish this, I would use JavaFXPorts[***20***] which has the ability to port JavaFX applications to iPhone, iPad & Android Phones/Tablets.

Cloud Integration - Introducing cloud storage options would enable users to back up their music libraries and metadata edits online, ensuring data integrity and availability across multiple devices which would work hand in hand with the Mobile Compatibility feature. This way a subscription-based model could be applied where users can pay for cloud storage to access their songs files on any device they have.

With the addition of these features, RetroSonic would be equipped to rival leading media players developed by major corporations with an addition of features that are not normally prevalent in mainstream players such as editing the metadata.

This project has taught me so much about development, how to implement different frameworks, APIs, external libraries, and using functional programming through lambda expressions; all stuff that was previously new to me. The requirement of this project from the projects list was to build a "simple music player" and I believe I have exceeded the expectations of not only this, but also my project proposal. I have implemented features such as playlists, frequently played lists, serializability & the ability to edit metadata some of which were not even planned for. This has now given me the notion that if I stay committed to a project, I could build any full-stack application that I put my mind to.

7 - BCS Criteria & Self-Reflection

This project is required to satisfy the BCS requirements for my degree program, below are the six criteria required:

1. An ability to apply practical and analytical skills gained during the degree programme.
2. Innovation and/or creativity.
3. Synthesis of information, ideas and practices to provide a quality solution together with an evaluation of that solution.
4. That your project meets a real need in a wider context.
5. An ability to self-manage a significant piece of work.
6. Critical self-evaluation of the process.

This is how my project satisfies the criteria below:

1. Practical and analytical skills have been showcased by the architecture of my music player, the programming knowledge I have polished over my degree has been displayed as well as software development methodologies learnt in my modules, which have been referenced in this report. I have been able to demonstrate I am able to use different libraries and frameworks which were new to me (JavaFX & MP3agic) and master them to implement more efficient algorithms. My analytical skills have been conveyed through in-depth analysis of audio-playback mechanisms, efficient library management and advanced playlist manipulation algorithms. Thus, I am able to alter my code to incorporate new features and analyse which lines of code can be excluded or altered to speed up my algorithms.
2. Innovation and creativity have been embodied in the User Interface, being built on scene builder, which aims to be minimalistic and intuitive, eliminating “clutter features” which are found on a lot of mainstream music players. My creativity will be on display with themes and layout of the User Interface.
3. My project synthesises the requirement information taken from my survey to see what features users find necessary within a music player. I have considered how users interact with the UI and apply best practices in the User Experience (UX). Software Engineering practices gained from my modules, such as modular coding, version control and AGILE development methodologies, have been implemented to create robust, high-quality code.
4. The project aims to address the need for a music player that combines music playback with the ability to edit metadata of songs, while also providing a streamlined Simplified User Interface that focuses on these core features. This means users who may not be computer literate can navigate the User Interface without issue. User surveys have been conducted to validate the requirements for the minimalist music player and gather feedback on desired features.
5. Self-management has been crucial in overseeing the various stages of development, including project planning, design, coding, and testing. Project management tools like Gantt charts have been utilised to track progress and followed strictly to meet milestones efficiently. This allowed the project to be completed ahead of schedule to make time for bug fixes, creation of the video and writing of the dissertation. I believe the Gantt Chart’s use was extremely understated in this report, it was vital in being able to keep up with not only the implementation of the project but also the other assessments such as the project video and this report. I recommend this to developers who find it hard to keep up with deadlines, as splitting the work up into sections and giving these sections deadlines instead works a lot more efficiently, as it makes it easier to hit checkpoints more regularly in your work. Overall, this has been instrumental in ensuring the timely and enhanced completion of my project.
6. Critical self-evaluation has involved regular code reviews, testing and debugging. It has also encompassed addressing challenges such as code/design enhancements and improvements within this report, which can be illustrated when reading this report, I have been extremely critical of my mistakes and making sure they’re known to the reader so that they do not make the same errors & I have also provided the reader with solutions for what I would do if I had to do this project from scratch again so that each of my errors has a given solution within the report. For example, this could be seen in the ***Evaluating SceneController Design***[*3.2.7.1*] section where I discuss how the use of three controllers would have made the controller better abide by the Single Responsibility, SOLID principles that I learnt about in ***COMP319-Software Engineering 2***. I discuss my reasons for not doing this was due to my inexperience and if I remembered the work I did in ***COMP228-App Development*** with my Swift Applications, I wouldn’t have made the same mistakes as I have experience with using a controller per scene. I have also discussed the way I would implement 3 controllers to reduce the redundancy of code caused by repetitive implementation of the multimedia buttons which improves modularity and decreases coupling of code. I have also discussed future features that I didn’t prioritise implementing in the ***Conclusion & Future Work*** Chapter *6*, while also portraying how they can be implemented so a reader wanting to

make a music app can implement the extra methods for themselves. Therefore, I believe I have been extremely critical of myself during the writing of this report & it's apparent now how I could have implemented my work better.

8 - References

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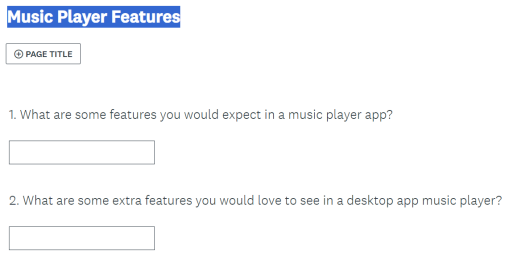
Appendix

A1

This is the blank survey I made on SurveyMonkey.com



Participants were informed their answers would be used as requirements for my application for this dissertation, and their responses were made anonymous as shown bellow: