BACS2003

ARTIFICIAL INTELLIGENCE

202401 Session, Year 2023/24

Assignment Documentation

Project Title: ***Song Recommendation System***

Programme: RSD Y2S3

Tutorial Group: 3

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Team members' data

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1. Introduction

1.1. Problem Background

In this modern generation,song has played a crucial role in our lives and is an inherent aspect of human culture. In previous eras, humans first used LP Records, Broadcast Radio, Cassette Tapes & Walkman, CDs, MP3 & iPod that only can listen to the song that is saved in it to listen to song.With the growth of the times and the advancement of technology, we would be able to browse and select what they wanted to listen to .There are various of streaming service that enable people to listening to song anytime and anywhere.For example,compared to other ways of providing song there are streaming services like Spotify, Pandora, and Apple Music, listeners can download song, create playlists, and save and revisit their favorite songs with just a click(MusicWorx, 2023).

Unfortunately,with many song items available on the Internet, the task of finding acceptable and preferred song has become difficult(Perera et al., n.d.).This is due to the fact that the sheer collection of song ranging from different genres,artists,and styles.In this case,this makes the users find song that is suitable with their tastes and preferences.This abundance of choice can lead to decision fatigue and dissatisfaction among users who struggle to navigate through the vast selection of song available across various platforms. In this situation,the users may feel overwhelmed and struggle to make selections amidst countless options.

Beside, there are various types of songslike electronic dance music,rock music ,jazz, dubstep, rhythm and blues, techno, country music ,electro, indie rock and pop music that different types of users choose to listen to .In this case ,every different individual tastes can vary widely based on factors like genre, mood, tempo, and personal history. Then, it may happen that the case may not adequately address these nuanced preferences, leaving users dissatisfied with generic recommendations or unable to effectively explore new genres or emerging artists.When users keep listening to songs that don't fit their preferences as recommended by the platform, they will eventually grow frustrated at not being able to find what they want to listen to.

In conclusion, the problem of difficulty finding the acceptable and preferred songs faced by users in navigating the vast landscape of online song platforms highlights the important need for advanced song recommendation systems that can effectively address the complexities of individual preferences. By overcoming these challenges, song recommendation systems can significantly enhance user satisfaction and engagement in the digital song ecosystem.

1.2. Objectives/Aims

The objective of implementing a song recommendation system is to enhance user satisfaction and engagement by delivering personalized and relevant song suggestions that optimize the song discovery process and overall user experience. The aim of the song recommendation system is to introduce users to new artists and songs that align with their tastes, promoting song exploration and engagement. Additionally, the system seeks to reduce decision fatigue and enhance user satisfaction by presenting tailored and enjoyable song suggestions that resonate with each user's preferences. Furthermore, the song recommendation system will continuously learn and adapt its recommendation algorithms to evolve with changing user preferences, ensuring that recommendations remain up-to-date and reflective of individual musical interests over time. By achieving these aims and objectives, the song recommendation system aims to create a user-centric platform that maximizes user engagement and enjoyment of song content.

1.3. Motivation

A song recommender system holds significant potential for both commercialization and social impact. From a commercial standpoint, the potential commercialization value of the song recommendation system is enhances the streaming platform. This is due to the reasons that song recommender systems can be integrated into streaming platforms like Spotify, Apple song, or YouTube Music to enhance user engagement and satisfaction by recommending user song based on preference.For example,a user who also listen to Ed Sharen will be recommend others song of Ed Sheren.In this case,user will feel satisfaction when using the music platform.This can lead to increased subscriber retention and acquisition.Beside,targeted advertising can be one of the potential commercialization value of the song recommendation system too.It will utilizing user data and preference to deliver advertisement that are highly relevant and personalized by analyzing user's listening history,song type and favourite artist .For example, a user who like to listen to kpop song will be identify suitable opportunities to display ads related to kpop song merchandise, concert tickets, music festivals, or other relevant products and services by the system.In this situation,this method not only enhance user experience but also increase the effectiveness of advertising.

On the social front, social impacts that a song recommender system might lead to is discovery of new songs to users. By analyzing the user's listening habits and preference,the system will recommend the user's song with the user's unique tastes. In this case,both user and artist can get benefits from this.The user is able to get into new song that matches with their taste and the artist is able to promote their song to more users.Moreover, personalized recommendations improve the overall experience listening to song , making it more inclusive and enjoyable for users from different backgrounds.This is due to reasons that the system will recommend the user song base on their interest instead of base on the popular on the trend.In conclusion, a well-implemented song recommender system not only benefits commercial entities but also enriches the social fabric of song consumption by encouraging exploration and appreciation of diverse musical expressions.

1.4. Timeline/Milestone

Activity	Start Date	End Date
Meeting to select topics	6/03/2024	6/03/2024
Meeting to select title for our topics	15/03/2024	15/03/2024
Introduction		
Discussing and writing introduction	16/03/2024	28/03/2024
Meeting for checking and do modifications for introduction	30/03/2024	30/03/2024
Research Background		
Discussing and writing research background	2/04/2024	10/04/2024
Meeting for checking and do modifications for research background	12/04/2024	12/04/2024
Deployment		
Meeting to deploy the song recommendation system	17/04/2024	17/04/2024
Meeting to enhance the song recommendation system	19/04/24	19/04/24
Meeting to add user interface for the song recommendation system	20/04/24	20/04/24
Meeting to do error testing of the song recommendation system	21/04/24	21/04/24
Let different users test the song recommendation system	21/04/24	23/04/24
Methodology		
Discussing and writing methodology	24/04/2024	26/04/2024
Meeting for checking Methodology	27/04/2024	27/04/2024

Result,Discussion & Conclusion		
Discussing and writing result,discussion & conclusion	28/04/2024	1/052024
Meeting to do the final checking	2/05/2024	2/05/2024

2. Research Background

2.1. Background of the applications

Recommender systems used to to predict the “rating” or “preference” that a user would give to an item and recommend the most relevant items to users. The aim of developing recommender systems is to reduce information overload by retrieving the most relevant information and services from a huge amount of data, thereby providing personalized services (Lu et al., 2015). By providing personalized services, it can analyze customer behavior and preferences to improve customer satisfaction.The main recommendations techniques include collaborative filtering, content-based filtering and hybrid recommender system.

Collaborative filtering is one of the earliest and most popular approaches which can recommend items by leveraging the preferences of other users.Collaborative filtering (CF)-based recommendation techniques help people to make choices based on the opinions of other people who share similar interests (Lu et al., 2015). It assumes that if two users have similar preferences in the past, they are likely to share similar preferences in future. There are two types of collaborative-filtering which are user-based and item-based collaborative filtering approaches. In a user-based collaborative filtering, users who are similar to them will recommend items to them. In an item-based collaborative filtering, users will be given recommendations for products that look like those they have previously been interested in. Research in collaborative filtering explores various methods for neighborhood-based methods, matrix factorization and hybrid approaches that combine multiple recommendation strategies.

Besides that, content-based filtering recommends items similar to those a user has liked in the past. To compare each item's attributes with the user profile so that only items that have a high degree of similarity with the user profile will be recommended (Pazzani & Billsus, 2007). For example, a user who has previously rated a science fiction highly so that the content-based recommender system would identify other science fiction in the list with similar keywords and genres, and recommend them to the user. Research in content-based filtering focuses on feature extraction, text analysis and machine learning algorithms to model user preferences based on item attributes.

Furthermore, hybrid recommendation systems combine two or more recommendation techniques to improve accuracy and coverage. The most common practice in the existing hybrid recommendation techniques is to combine the collaborative filtering recommendation techniques with the other recommendation techniques in an attempt to avoid cold-start, sparseness and/or scalability problems (Bellogín et al., 2013). Research in hybrid recommender systems examines methods for effectively combining different recommendation algorithms, such as collaborative filtering and content-based filtering to provide more personalized and diverse recommendations.For example, if a user's collaborative filtering profile indicates a preference for pop music and their content-based profile shows a liking for songs with upbeat tempo, the system might recommend popular pop songs with a fast tempo.

Overall, research in the recommender systems is a multidisciplinary field that continues to evolve with advances in machine learning, data mining and user modeling, focusing on providing personalized and relevant recommendations to users who have integrated into a wide range of industries such as e-business, e-commerce, e-learning, e-government and so on.

2.2. Analysis of selected tool with any other relevant tools

Tools comparison	**Remark**	**Selected tool's name:**Jupyter Notebook	**Other tool's name:**Google Colab	**Other tool's name:**Visual Studio Code
Type of license and open source license	State all types of license	Open Source (BSD)	Proprietary	Open Source (MIT)
Year founded	When is this tool being introduced?	2014	2018	2015
Founding company	Owner	Project Jupyter	Google	Microsoft
License Pricing	Compare the prices if the license is used for development and business/commercialization	Free	Free	Free
Supported features	What features that it offers?	1. Interactive Notebooks 2. Code Execution 3. Extensions	1. Interactive Notebooks 2. Code Execution 3. Collaboration Tools	1. Interactive Notebooks 2. Code Execution 3. Collaboration Tools 4. Extensions 5. Debugging Tools
Common applications	In what areas this tool is usually used?	1. Data Analysis 2. Machine Learning 3. Research and Education	1. Data Analysis 2. Machine Learning 3. Research and Education 4. Software Development	1. Data Analysis 2. Machine Learning 3. Research and Education 4. Software Development
Customer support	How the customer support is	Online Community	Google Support	Microsoft Support

	given, e.g. proprietary, online community, etc.			
Limitations	The drawbacks of the software	1. Offline usage requires local installation 2. Running large computations	1. Offline usage can be limited without internet 2. Resource limits for GPU usage 3. Limited collaboration tools compared to some platforms	1. Offline Usage requires local installation 2. Resource-intensive for large projects 3. Steeper Learning Curve due to extensive features 4. Some specialized needs may not have readily available extensions

2.3. Justify why the selected tool is suitable

Jupyter Notebook is a suitable tool for developing the song recommendation system compared with Google Colab and Visual Studio Code. The first reason why is Jupyter Notebooks's **open source nature**, which is licensed under BSD, which cultivates a collaborative environment to enable contributions from the online community. This openness encourages innovation and facilitates the sharing of ideas and code snippets, which can be invaluable when completing a complex project like a recommender system.

In addition to that, Jupyter Notebook's **interactive notebook interface** provides a highly intuitive way to explore data, experiment with algorithms and visualize results in graphs or diagrams within a single environment. Therefore, it is beneficial for iterative testing and adjusting of algorithms are essential to ensure accurate recommendations in developing the song recommendation system.

Furthermore, Jupyter Notebook offers **seamless integration with multiple programming languages**, including Python that is a popular language for machine learning and data analysis, as it is suitable for implementing the algorithms and models that are needed for the song recommender system. The ability to execute code cells individually allows for quick prototyping and debugging, thus streamlining the development process.

While Google Colab provides similar collaborative features and cloud-based computing resources that may present limitations in terms of customization and dependency management. Moreover, Visual Studio Code usually is used for general-purpose programming tasks but may lack specialized features and visualizations customization on data exploration and machine learning experimentation.

In conclusion, Jupyter Notebook is a suitable tool for developing the song recommender system due to its open-source nature, interactive user interface and smooth integration with relevant programming languages and libraries. Hence, it enables efficient collaboration, rapid prototyping and iterative development, eventually helps in the process of developing an accurate recommender system.

3. Methodology

3.1. Description of dataset

Sources:
https://www.kaggle.com/code/aryaupadhyay95/spotify-and-youtube-data-analysis/input

The source of the dataset used in the song recommendation system comes from Kaggle, which is a data science platform and online community of data scientists to allow users to search for dataset in developing AI models. It hosts a wide range of datasets, competitions and kernels for data analysis and machine learning projects. The dataset file is named “Spotify_Youtube.csv”. It consists of 20718 rows and 28 columns , where each row represents as a single song data and each column represents as a variable or feature. It highlights a file named “songDS.csv” that was extracted from “Spotify_Youtube.csv” to analyze data.

3.1.1 songDS.csv

Field Name	**Description**
Artist	Artist of the song used for analysis
Song	Name of the song
Link	Url of the video linked to the song on Youtube
Original_artist	Artist of the song display in the recommended song list

3.1.2 Spotify and Youtube.csv

Field Name	**Description**
Artist	Name of the artist
Url_spotify	The Url of the artist
Track	Name of the song displayed on Spotify
Album	The album in which the song on Spotify
Album_type	Indicates if the song is released on Spotify as a single or contained in an album
Uri	Spotify link used to redirect to the song through the API
Danceability	Describes how suitable a track is for dancing based on a

	combination of musical elements including tempo, rhythm
Energy	Perceptual measure of intensity and activity
Key	The key the track is in
Loudness	Overall loudness of a track in decibels(dB)
Speechiness	Detects the presence of spoken words in a track
Accousticness	Measure whether the track is acoustic
Instrumentalness	Predicts whether a track contains no vocals
Liveness	Detects presence of an audience in the recording
Valence	Describe the musical positiveness conveyed a track
Tempo	Overall estimated tempo of track in beats per minute(BPM)
Duration_ms	Duration of the track in milliseconds
Url_youtube	Url of the video linked to the song on Youtube
Title	Title of the videoclip on youtube
Channel	Name of the channel that have published the video
Views	Number of views
Likes	Number of likes
Comments	Number of comments
Description	Description of the video on Youtube
Licensed	Indicates whether the video represents licensed content, which means that the content was uploaded to a channel linked to a Youtube content partner and then claimed by that partner
Offcial_video	Boolean value that indicates if the video found is the official video of the song
Stream	Number of streams of the song on Spotify

3.2. Applications of the algorithm(s)

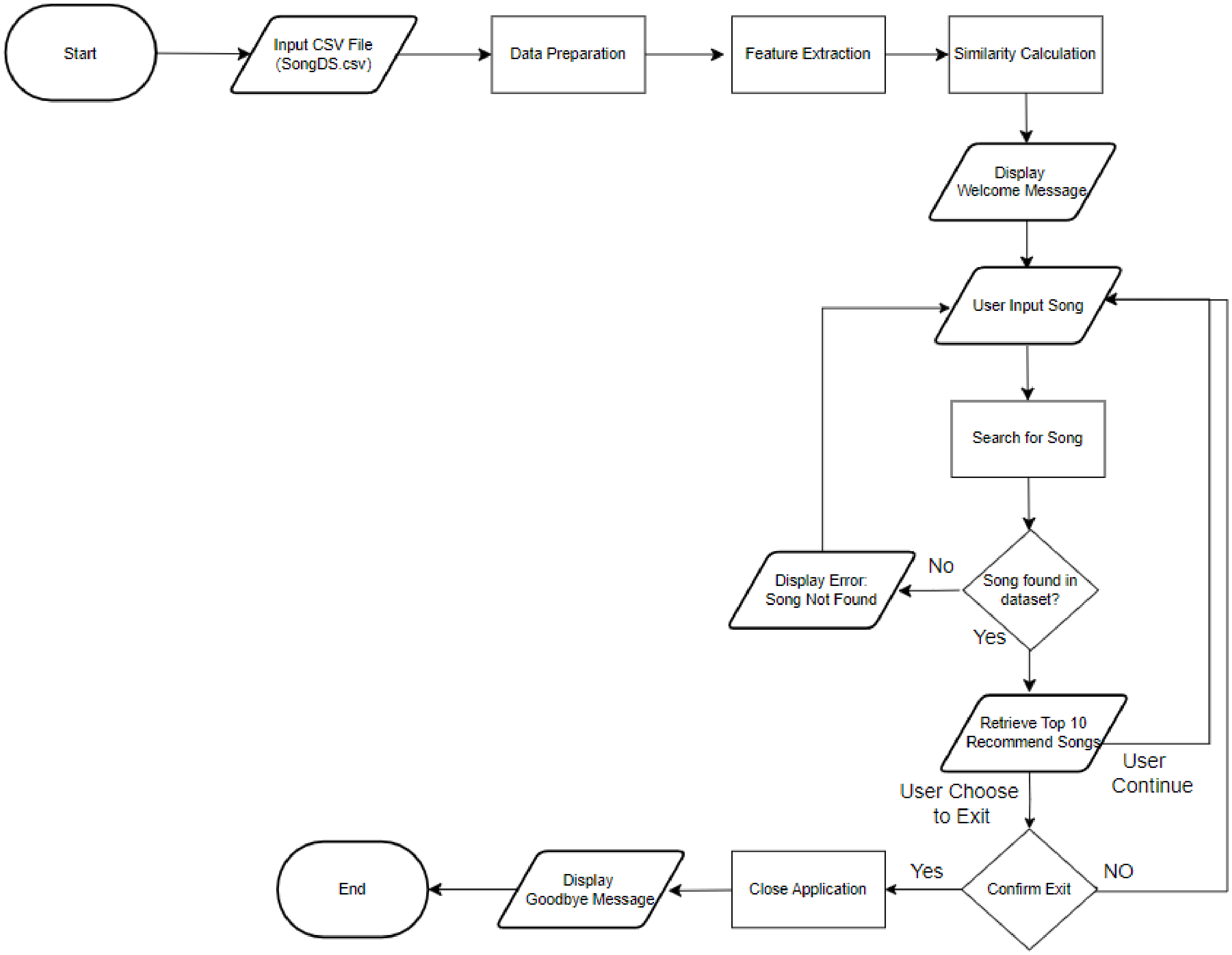
The technique used in the song recommendation system is **cosine similarity**. In NLP, it is frequently used for tasks such as text mining, sentiment analysis, and document clustering (Understanding Cosine Similarity in Python With Scikit-Learn, n.d.). First, the system will preprocess the dataset by cleaning the data including dropping duplicate songs and null values in ‘song’ and ‘link’ columns. It also combines the ‘artist’ and ‘song’ columns into a single ‘combined’ column that is served for cosine similarity calculation.

Second, the song recommendation system implements a **‘CountVectorizer’** from ‘scikit-learn’ library. CountVectorizer is a text preprocessing technique commonly used in natural language processing (NLP) tasks for converting a collection of text documents into a numerical representation (Van Otten, 2023). In the system, it converts the ‘combined’ column into a matrix of token counts as each row represents a song and each column represents a unique word that exists in the dataset. Each cell in the matrix means the frequency of the corresponding word in the song’s text.

Third, it will apply a cosine similarity algorithm to calculate the cosine angle between all vectors created by ‘CountVectorizer’. For example, it measures the similarity between 2 songs based on the angle between their vector representations in the vectorized space. As a result, a new data frame will be created with similarity scores, indexed by song names. Then, the song recommendation system imports the 'tkinter’ library to design the Graphical User Interface(GUI) of the system. It consists of an input frame for users to input a song, a button to get recommended songs, a suggestion listbox for autocomplete suggestions and a treeview widget to display the top recommended songs.

Last, the song recommendation system will retrieve the top 10 most similar songs based on cosine similarity scores when a user inputs a song name. It identifies the song’s index in the cosine similarity matrix, retrieves the corresponding row and selects the top similar songs based on the highest cosine similarity scores. The recommended songs are displayed in the treeview widget, including song name, artist and a url of the video of the song linked to the Youtube for users to click and access.

3.3. System flowchart/activity diagram



3.4. Proposed test plan/hypothesis

Hypothesis

H1 : Song recommendation system improves user satisfaction scores compared to not using the system.

H2 : The song recommendation system increases user engagement metrics compared to not use the system.

H3 :The song recommendation system increases the number of new artists and songs explored by users compared to their behavior before using the system.

Test Plan

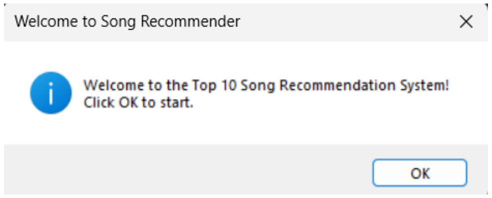
The objective of the test plan is to verify the hypothesis statement. We plan to test our song recommender system by asking a group of students to use it for three days. These students have different song tastes, which helps us see how well our system works for everyone. During the period, we will let them input the songs they like, and the system will recommend some songs for them.

At the end of the period, we'll give the students a survey to fill out. This survey will ask them how much they liked the song recommendations, how easy the system was to use, and what they think could be better. They'll answer some questions with ratings and others in their own words.

After the test, we'll look at all the information we gathered to see how satisfied the students were and what suggestions they had for making the system better. We'll put all these findings into a report that explains what we did, what we found out, and what changes we think should be made to improve the system. Based on this feedback, we'll make some updates and might test the system again to see if these changes helped.

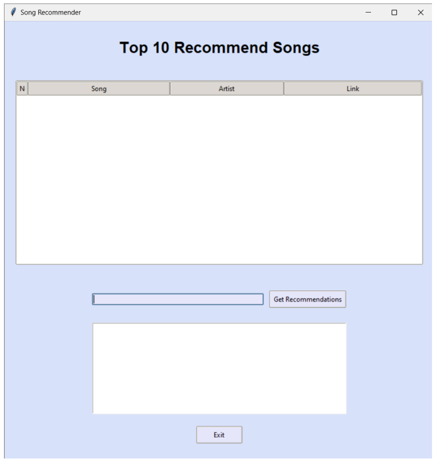
Test Scenario	1	**Test Case**	1
Test Case Description	Launch the system using jupyter notebook	**Test Priority**	High
Pre-Requisite	Installed jupyter notebook	**Post-Requisite**	User able to see welcome screen

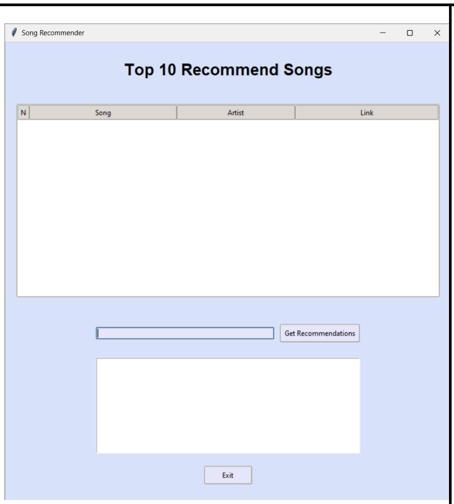
Test Execution Steps:

S.No	**Action/scenario**	**Test data**	**Expected Output**	**Actual Output**	**Test Browser**	**Test Result**	**Test Comments**
1	Lauch Song Recommender System[Valid]	-	Prompt welcome screen to the user	 Welcome to Song Recommender Welcome to the Top 10 Song Recommendation System! Click OK to start. OK			
2	Not able to launch Song Recommender System [Invalid]	-	Error message show in jupyter notebook				

Test Scenario	2	**Test Case**	2
Test Case Description	Able to get into the system interface	**Test Priority**	High
Pre-Requisite	Successfully launched the system	**Post-Requisite**	User able to see welcome screen

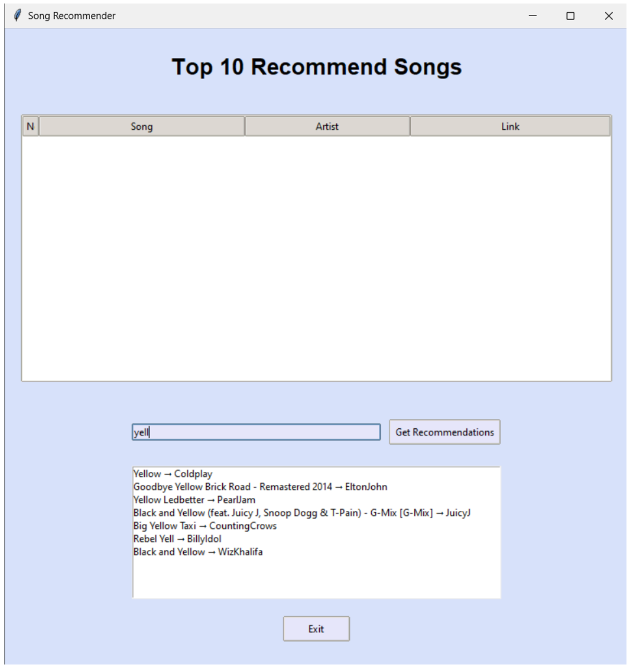
Test Execution Steps:

S.No	Action/scenario	Test data	Expected Output	Actual Output	Test Browser	Test Result	Test Comments
1	Click “ok” button on the welcome screen [Valid]	-	Enter the Song Recommender System interface	 Song Recommender Top 10 Recommend Songs N Song Artist Link Get Recommendations Exit			
2	Not able click “ok” button on the welcome screen [Invalid]	-	Error message show in jupyter notebook				

3	Click “x” button on the top right of welcome screen[Valid]	-	Enter the Song Recommender System interface	 Song Recommender Top 10 Recommend Songs N Song Artist Link Get Recommendations Exit			
4	Not able to click “x” button on the top right welcome screen[Invalid]	-	Error message show in jupyter notebook				

Test Scenario	3	**Test Case**	3
Test Case Description	Input data and display auto fill listing	**Test Priority**	High
Pre-Requisite	Entered the interface of Song recommender system	**Post-Requisite**	Autofill listing displayed

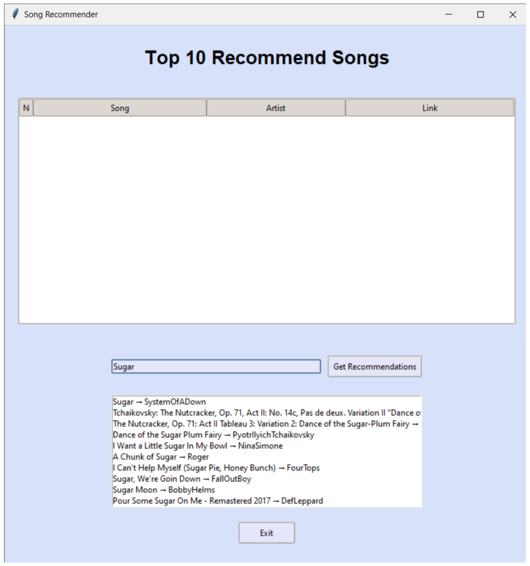
Test Execution Steps:

S.No	Action/scenario	Test data	Expected Output	Actual Output	Test Browser	Test Result	Test Comments
1	Enter data into the textbox[Valid]	“yell”	Will show autofill listing	 Song Recommender Top 10 Recommend Songs N | Song | Artist | Link yell Get Recommendations Yellow → Coldplay Goodbye Yellow Brick Road - Remastered 2014 → EltonJohn Yellow Ledbetter → PearlJam Black and Yellow (feat. Juicy J, Snoop Dogg & T-Pain) - G-Mix [G-Mix] → JuicyJ Big Yellow Taxi → CountingCrows Rebel Yell → BillyIdol Black and Yellow → WizKhalifa Exit			

2	Enter data into the texbar[Invalid]	“sqwert”	Will not show autofill listing				

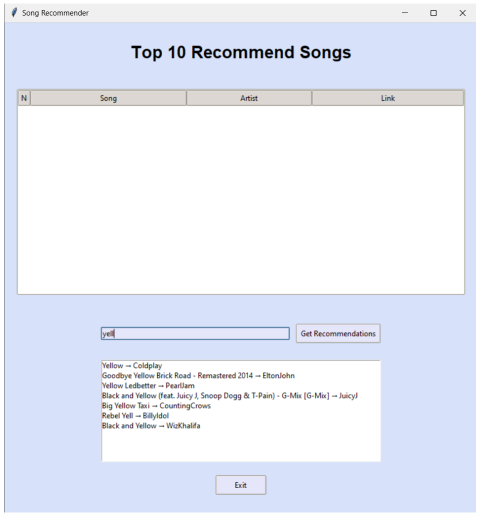
Test Scenario	4	**Test Case**	4
Test Case Description	Access autofill listing	**Test Priority**	High
Pre-Requisite	Autofill listing displayed	**Post-Requisite**	Able to fill in song name by clicking autofill listing

Test Execution Steps:

S.No	Action/scenario	Test data	Expected Output	Actual Output	Test Browser	Test Result	Test Comments
1	Able to click the one row autofill list[Valid]	option:sugar	The text box will autofill in selected row	 Song Recommender Top 10 Recommend Songs N Song Artist Link Get Recommendations Exit Sugar Sugar → SystemOfADown Tchaikovsky: The Nutcracker, Op. 71, Act II: No. 14c, Pas de deux. Variation II "Dance o The Nutcracker, Op. 71: Act II Tableau 3: Variation 2: Dance of the Sugar-Plum Fairy → Dance of the Sugar Plum Fairy → PyotrIlyichTchaikovsky I Want a Little Sugar In My Bowl → NinaSimone A Chunk of Sugar → Roger I Can't Help Myself (Sugar Pie, Honey Bunch) → FourTops Sugar, We're Goin Down → FallOutBoy Sugar Moon → BobbyHelms Pour Some Sugar On Me - Remastered 2017 → DefLeppard			
2	Not able to click the one row autofill list[Invalid]	-	-				

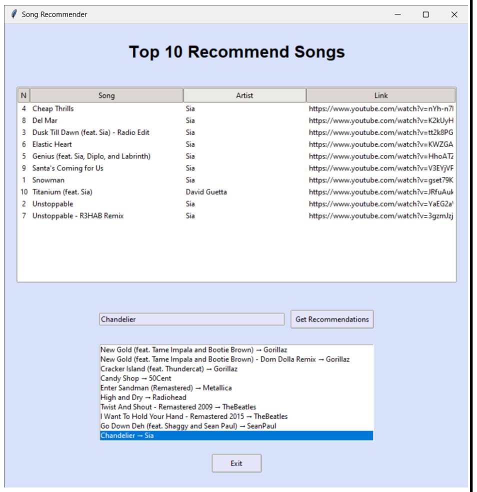
Test Scenario	5	**Test Case**	5
Test Case Description	Get recommended song	**Test Priority**	High
Pre-Requisite	Filled in song name	**Post-Requisite**	User able to see recommended songs

Test Execution Steps:

S.No	Action/scenario	Test data	Expected Output	Actual Output	Test Browser	Test Result	Test Comments
1	Click “Get Recommendations” button[Valid]	-	Will show 10 recommended songs	 Song Recommender Top 10 Recommend Songs N | Song | Artist | Link yell Yellow → Coldplay Goodbye Yellow Brick Road - Remastered 2014 → EltonJohn Yellow Ledbetter → PearlJam Black and Yellow (feat. Juicy J, Snoop Dogg & T-Pain) - G-Mix [G-Mix] → JuicyJ Big Yellow Taxi → CountingCrows Rebel Yell → BillyIdol Black and Yellow → WizKhalifa 			
2	Click “Get Recommendations” button[Invalid]	-	Will prompt an error message				

Test Scenario	6	**Test Case**	6
Test Case Description	Sort the song list	**Test Priority**	High
Pre-Requisite	Recommended song list has generated	**Post-Requisite**	User able to sort the song by “No”, “Song”or “Artist”

Test Execution Steps:

S.No	Action/scenario	Test data	Expected Output	Actual Output	Test Browser	Test Result	Test Comments
1	Click the title of “No”, “Song”or “Artist”[Valid]	-	Will sort Songs ascending or descending by “No”, “Song”or “Artist”				
2	Click the title of “No”, “Song”or “Artist”[Invalid]	-	Will not sort Songs ascending or descending by “No”, “Song”or “Artist”				

Top 10 Recommend Songs

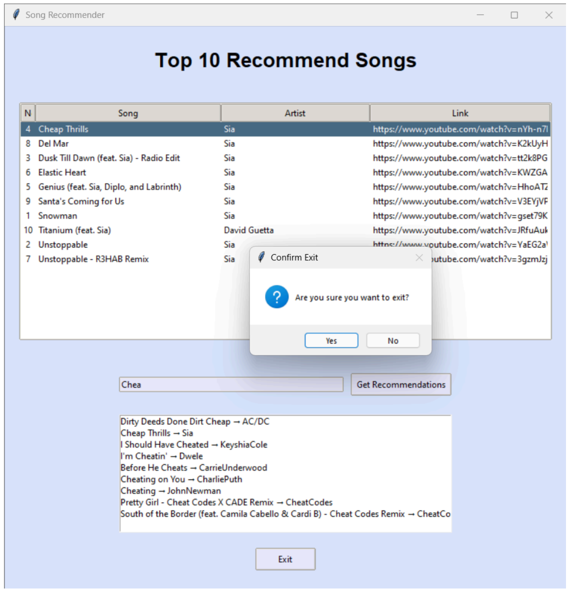
N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7I
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG
6	Elastic Heart	Sia	https://www.youtube.com/watch?v=KWZGA
5	Genius (feat. Sia, Diplo, and Labrinth)	Sia	https://www.youtube.com/watch?v=HhoATz
9	Santa's Coming for Us	Sia	https://www.youtube.com/watch?v=V3EYjVF
1	Snowman	Sia	https://www.youtube.com/watch?v=gset79K
10	Titanium (feat. Sia)	David Guetta	https://www.youtube.com/watch?v=JRfuAuk
2	Unstoppable	Sia	https://www.youtube.com/watch?v=YaEG2a
7	Unstoppable - R3HAB Remix	Sia	https://www.youtube.com/watch?v=3gzmJzj

Chandelier

New Gold (feat. Tame Impala and Bootie Brown) → Gorillaz
New Gold (feat. Tame Impala and Bootie Brown) - Dom Dolla Remix → Gorillaz
Cracker Island (feat. Thundercat) → Gorillaz
Candy Shop → 50Cent
Enter Sandman (Remastered) → Metallica
High and Dry → Radiohead
Twist And Shout - Remastered 2009 → TheBeatles
I Want To Hold Your Hand - Remastered 2015 → TheBeatles
Go Down Deh (feat. Shaggy and Sean Paul) → SeanPaul
Chandelier → Sia

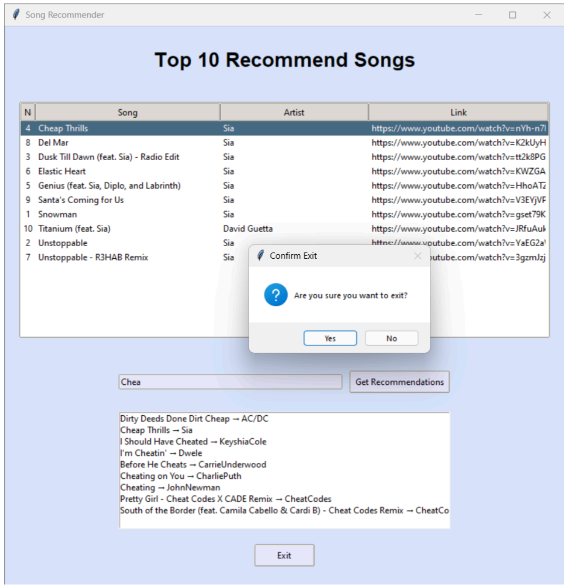
Test Scenario	7	**Test Case**	7
Test Case Description	Exit from the system	**Test Priority**	High
Pre-Requisite	Entered the interface of Song recommender system	**Post-Requisite**	User able to see confirmation message

Test Execution Steps:

S.No	**Action/scenario**	**Test data**	**Expected Output**	**Actual Output**	**Test Browser**	**Test Result**	**Test Comments**
1	Click "x" button on the top right of Song Recommender interface[Valid]	-	Prompt confirmation message	 Top 10 Recommend Songs N Song Artist Link 4 Cheap Thrills Sia https://www.youtube.com/watch?v=nYh-n7I 8 Del Mar Sia https://www.youtube.com/watch?v=K2kUyH 3 Dusk Till Dawn (feat. Sia) - Radio Edit Sia https://www.youtube.com/watch?v=tt2k8PG 6 Elastic Heart Sia https://www.youtube.com/watch?v=KWZGA 5 Genius (feat. Sia, Diplo, and Labrinth) Sia https://www.youtube.com/watch?v=HhoATz 9 Santa's Coming for Us Sia https://www.youtube.com/watch?v=V3EYjVF 1 Snowman Sia https://www.youtube.com/watch?v=gset79K 10 Titanium (feat. Sia) David Guetta https://www.youtube.com/watch?v=JRfuAuk 2 Unstoppable Sia https://www.youtube.com/watch?v=YaEG2a 7 Unstoppable - R3HAB Remix Sia utube.com/watch?v=3gzmJzj Confirm Exit Are you sure you want to exit? Chea Dirty Deeds Done Dirt Cheap → AC/DC Cheap Thrills → Sia I Should Have Cheated → KeyshiaCole I'm Cheatin' → Dwele Before He Cheats → CarrieUnderwood Cheating on You → CharliePuth Cheating → JohnNewman Pretty Girl - Cheat Codes X CADE Remix → CheatCodes South of the Border (feat. Camila Cabello & Cardi B) - Cheat Codes Remix → CheatCo 			
2	Not able to click "x" button on the top right of Song Recommender	-	Not able to prompt confirmation message				

Test Scenario	7	**Test Case**	7
Test Case Description	Exit from the system	**Test Priority**	High
Pre-Requisite	Entered the interface of Song recommender system	**Post-Requisite**	User able to see confirmation message

Test Execution Steps:

	interface[Invalid]						
3	Click "Exit" button on the top right of Song Recommender interface[Valid]	-	Prompt confirmation message				
4.	Not able to click "Exit" button on the top right of Song Recommender interface[Invalid]	-	Not able to prompt confirmation message				

Song Recommender

Top 10 Recommend Songs

N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7l
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG
6	Elastic Heart	Sia	https://www.youtube.com/watch?v=KWZGA
5	Genius (feat. Sia, Diplo, and Labrinth)	Sia	https://www.youtube.com/watch?v=HhoATz
9	Santa's Coming for Us	Sia	https://www.youtube.com/watch?v=V3EYjVF
1	Snowman	Sia	https://www.youtube.com/watch?v=gset79K
10	Titanium (feat. Sia)	David Guetta	https://www.youtube.com/watch?v=JRfuAuk
2	Unstoppable	Sia	https://www.youtube.com/watch?v=YaEG2a'
7	Unstoppable - R3HAB Remix	Sia	utube.com/watch?v=3gzmJzj

Confirm Exit

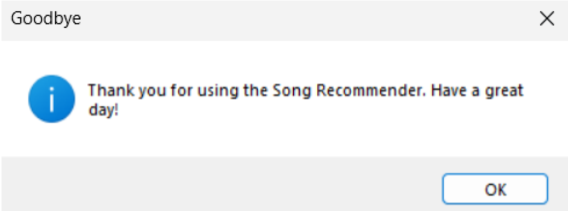
Are you sure you want to exit?

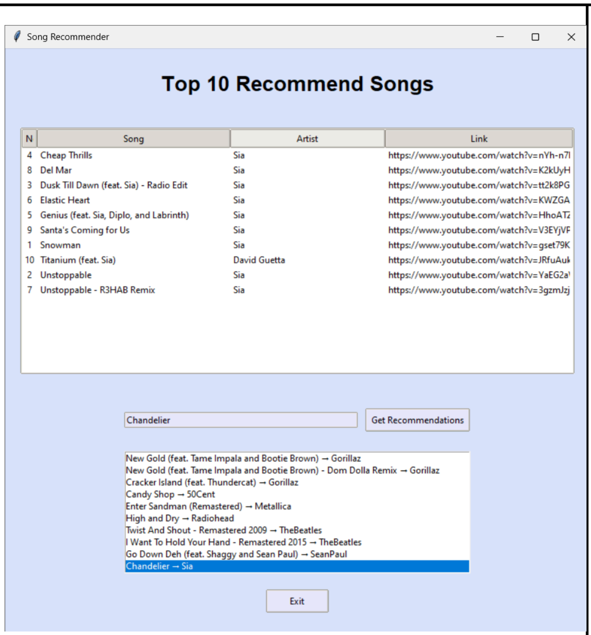
Chea

```
Dirty Deeds Done Dirt Cheap → AC/DC
Cheap Thrills → Sia
I Should Have Cheated → KeyshiaCole
I'm Cheatin' → Dwele
Before He Cheats → CarrieUnderwood
Cheating on You → CharliePuth
Cheating → JohnNewman
Pretty Girl - Cheat Codes X CADE Remix → CheatCodes
South of the Border (feat. Camila Cabello & Cardi B) - Cheat Codes Remix → CheatCo
```

Test Scenario	8	**Test Case**	8
Test Case Description	Confirm to exit the system	**Test Priority**	High
Pre-Requisite	Clicked “Exit” button or “x” button on the top right of Song recommender system	**Post-Requisite**	User able to see Goodbye screen

Test Execution Steps:

S.No	**Action/scenario**	**Test data**	**Expected Output**	**Actual Output**	**Test Browser**	**Test Result**	**Test Comments**
1	Click “Yes” button on confirmation message.[Valid]	-	Prompt Goodbye screen to the user	 Thank you for using the Song Recommender. Have a great day! 			
2	Not able to click the “Yes” button on the confirmation message.[Invalid]	-	Not able to prompt Goodbye screen to the user				

<table>
<tr><td colspan="2"><b>Test Scenario</b></td><td colspan="2">8</td><td colspan="2"><b>Test Case</b></td><td colspan="2">8</td></tr>
<tr><td colspan="2"><b>Test Case Description</b></td><td colspan="2">Confirm to exit the system</td><td colspan="2"><b>Test Priority</b></td><td colspan="2">High</td></tr>
<tr><td colspan="2"><b>Pre-Requisite</b></td><td colspan="2">Clicked “Exit” button or “x” button on the top right of Song recommender system</td><td colspan="2"><b>Post-Requisite</b></td><td colspan="2">User able to see Goodbye screen</td></tr>
<tr><td colspan="8"><b>Test Execution Steps:</b></td></tr>
<tr><td>3</td><td>Click the “No” button on the confirmation message.[Valid]</td><td>-</td><td>Back to the Song recommender interface</td><td>
Song Recommender
Top 10 Recommend Songs
<table>
<tr><th>N</th><th>Song</th><th>Artist</th><th>Link</th></tr>
<tr><td>4</td><td>Cheap Thrills</td><td>Sia</td><td>https://www.youtube.com/watch?v=nYh-n7l</td></tr>
<tr><td>8</td><td>Del Mar</td><td>Sia</td><td>https://www.youtube.com/watch?v=K2kUyH</td></tr>
<tr><td>3</td><td>Dusk Till Dawn (feat. Sia) - Radio Edit</td><td>Sia</td><td>https://www.youtube.com/watch?v=tt2k8PG</td></tr>
<tr><td>6</td><td>Elastic Heart</td><td>Sia</td><td>https://www.youtube.com/watch?v=KWZGA</td></tr>
<tr><td>5</td><td>Genius (feat. Sia, Diplo, and Labrinth)</td><td>Sia</td><td>https://www.youtube.com/watch?v=HhoATz</td></tr>
<tr><td>9</td><td>Santa's Coming for Us</td><td>Sia</td><td>https://www.youtube.com/watch?v=V3EYjVF</td></tr>
<tr><td>1</td><td>Snowman</td><td>Sia</td><td>https://www.youtube.com/watch?v=gset79K</td></tr>
<tr><td>10</td><td>Titanium (feat. Sia)</td><td>David Guetta</td><td>https://www.youtube.com/watch?v=JRfuAuk</td></tr>
<tr><td>2</td><td>Unstoppable</td><td>Sia</td><td>https://www.youtube.com/watch?v=YaEG2a'</td></tr>
<tr><td>7</td><td>Unstoppable - R3HAB Remix</td><td>Sia</td><td>https://www.youtube.com/watch?v=3gzmJzj</td></tr>
</table>
Chandelier
Get Recommendations
New Gold (feat. Tame Impala and Bootie Brown) → Gorillaz
New Gold (feat. Tame Impala and Bootie Brown) - Dom Dolla Remix → Gorillaz
Cracker Island (feat. Thundercat) → Gorillaz
Candy Shop → 50Cent
Enter Sandman (Remastered) → Metallica
High and Dry → Radiohead
Twist And Shout - Remastered 2009 → TheBeatles
I Want To Hold Your Hand - Remastered 2015 → TheBeatles
Go Down Deh (feat. Shaggy and Sean Paul) → SeanPaul
Chandelier → Sia
Exit</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>Not able to click the “No” button on the confirmation message.[Invalid]</td><td>-</td><td>Not able to prompt Goodbye screen to the user</td><td></td><td></td><td></td><td></td></tr>
</table>

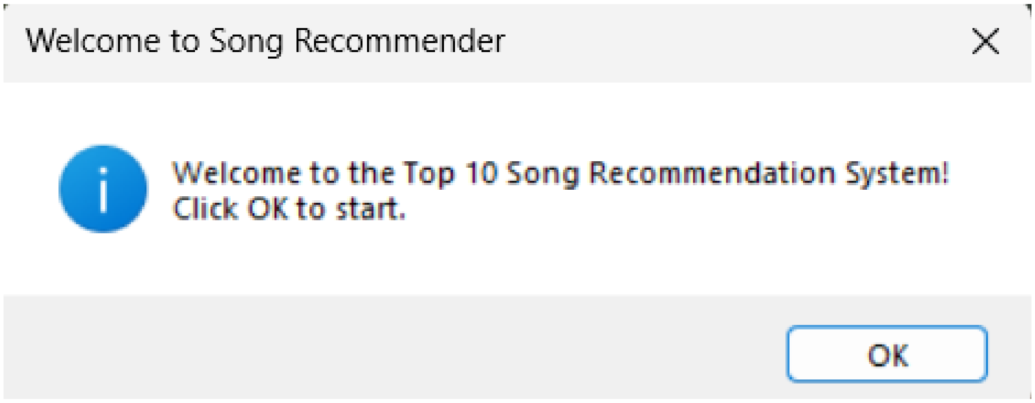
Test Scenario	9	**Test Case**	9
Test Case Description	Terminate the system	**Test Priority**	High
Pre-Requisite	Clicked “Yes” button on the confirmation message	**Post-Requisite**	User able to terminate the system

Test Execution Steps:

S.No	**Action/scenario**	**Test data**	**Expected Output**	**Actual Output**	**Test Browser**	**Test Result**	**Test Comments**
1	Able to click “x” button on the top right of confirmation message[Valid]	-	Terminate the system				
2	Not able to click “x” button on the top right of confirmation message[Invalid]	-	Not able to terminate the system				
3	Able to click “OK” button on Goodbye screen[Valid]	-	Terminate the system				
4	Not able to click “OK” button Goodbye screen[Invalid]	-	Not able to terminate the system				

4. Result

4.1. Results

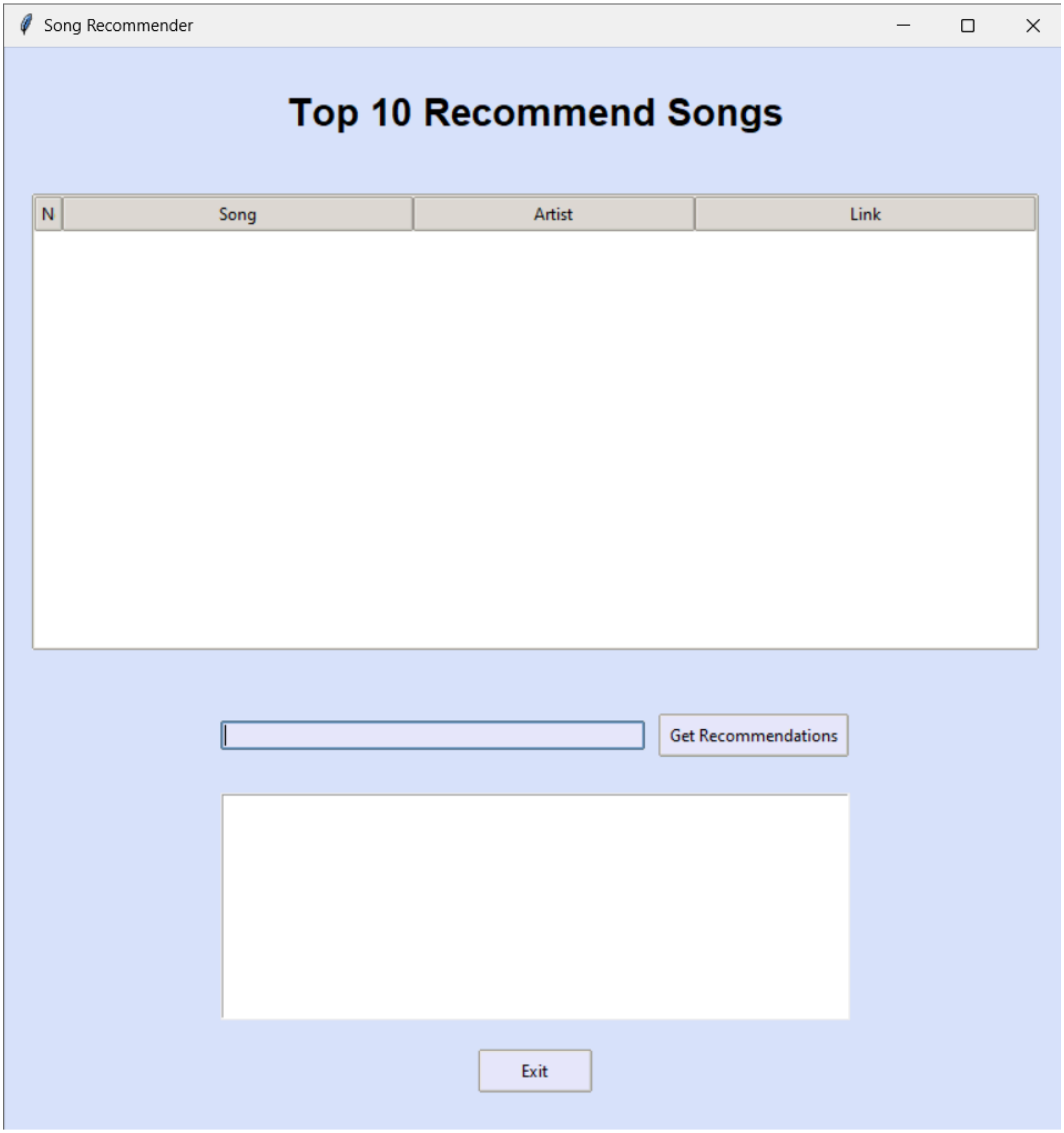


Welcome to Song Recommender

Welcome to the Top 10 Song Recommendation System!
Click OK to start.

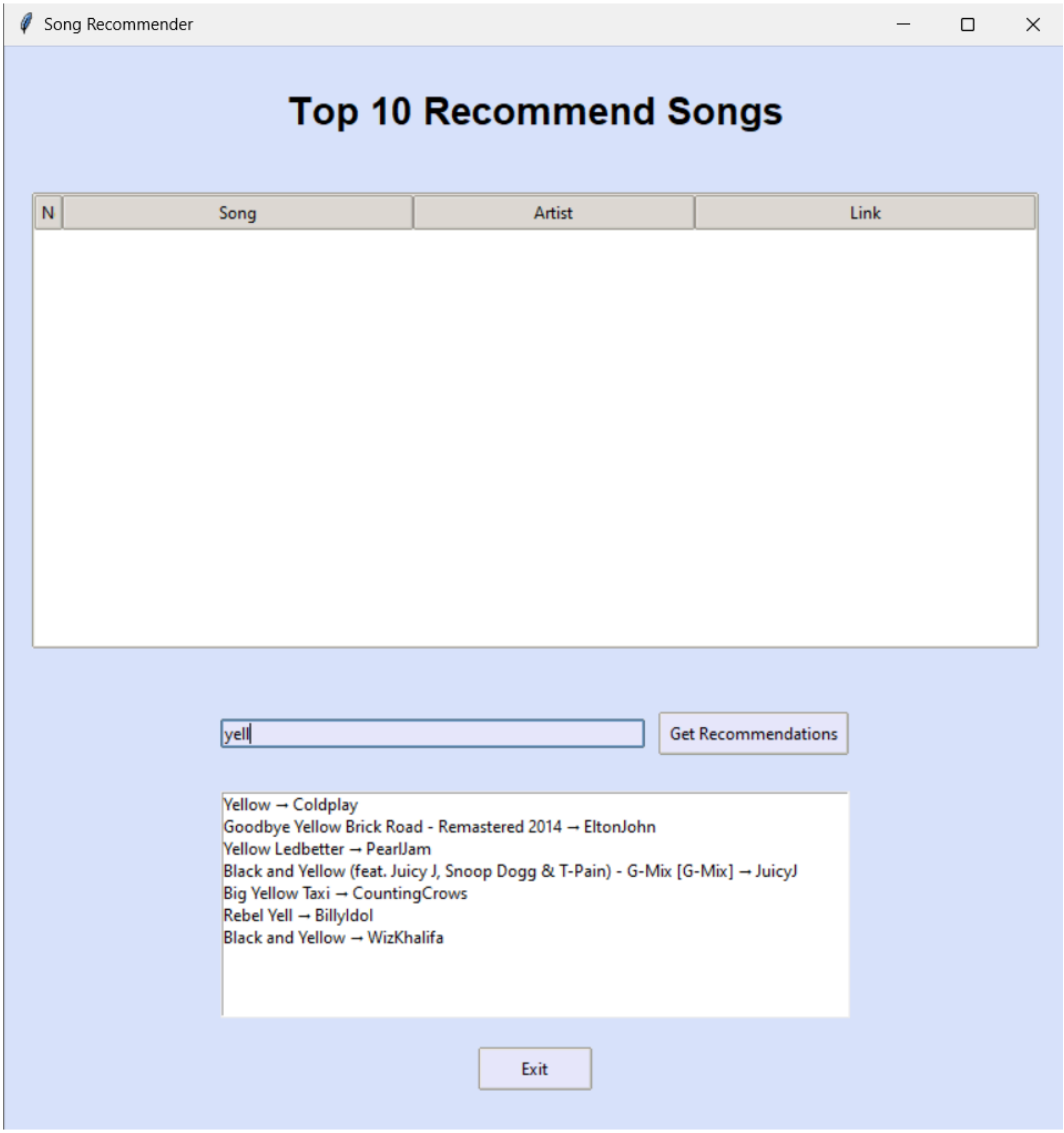
When the application is launched, it will display a welcoming screen.

When the program is run, it will create the main application window After that, a messagebox will appear showing the welcome message "Welcome to Song Recommender: Top 10 Song Recommendation System!



After clicking the 'OK' button, the user will be directed to the song recommender system.The main frame will list the top 10 recommended songs with the song's artist and a link that can be redirected to Youtube.

This step is facilitated by the root.deiconify() method, which makes the main window visible to the user. Additionally, the initialize_app(root) method is called to initialize and set up the components of the Song Recommender interface for interaction.



Top 10 Recommend Songs

N	Song	Artist	Link

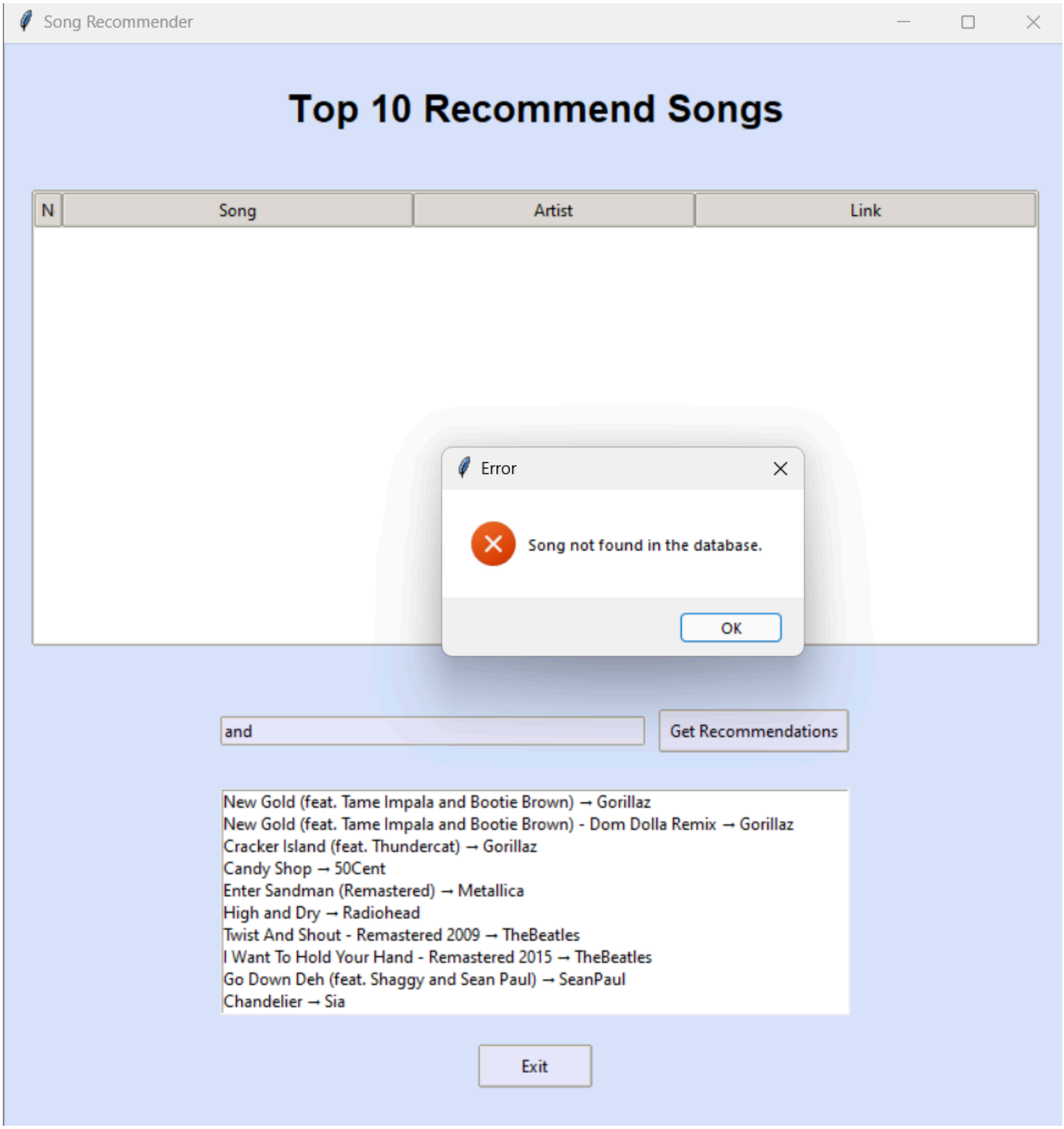
yell

```
Yellow → Coldplay
Goodbye Yellow Brick Road - Remastered 2014 → EltonJohn
Yellow Ledbetter → PearlJam
Black and Yellow (feat. Juicy J, Snoop Dogg & T-Pain) - G-Mix [G-Mix] → JuicyJ
Big Yellow Taxi → CountingCrows
Rebel Yell → BillyIdol
Black and Yellow → WizKhalifa
```

The system allows users to input a song name, presenting a suggestion list of songs based on their input below the input frame. This is accomplished by the update_suggestions() method, which listens for key release events ("<KeyRelease>") in the song entry field. As the user types, the method retrieves suggestions from the database that match the entered text and displays them in the suggestion listbox.

Users can either type the song name or select from the suggested songs. Clicking on a song from the list automatically populates the input field with the selected song. This functionality is achieved through the fill_entry_from_listbox() method, which listens for double-click events ("<Double-1>") on the suggestion listbox.

After inputting their choice, users can click the 'Get Recommendations' button or press 'Enter' on their keyboard. The system will then display the top 10 recommended songs.This functionality is implemented through binding the "Return" key ("<Return>") to the show_recommendations() method.

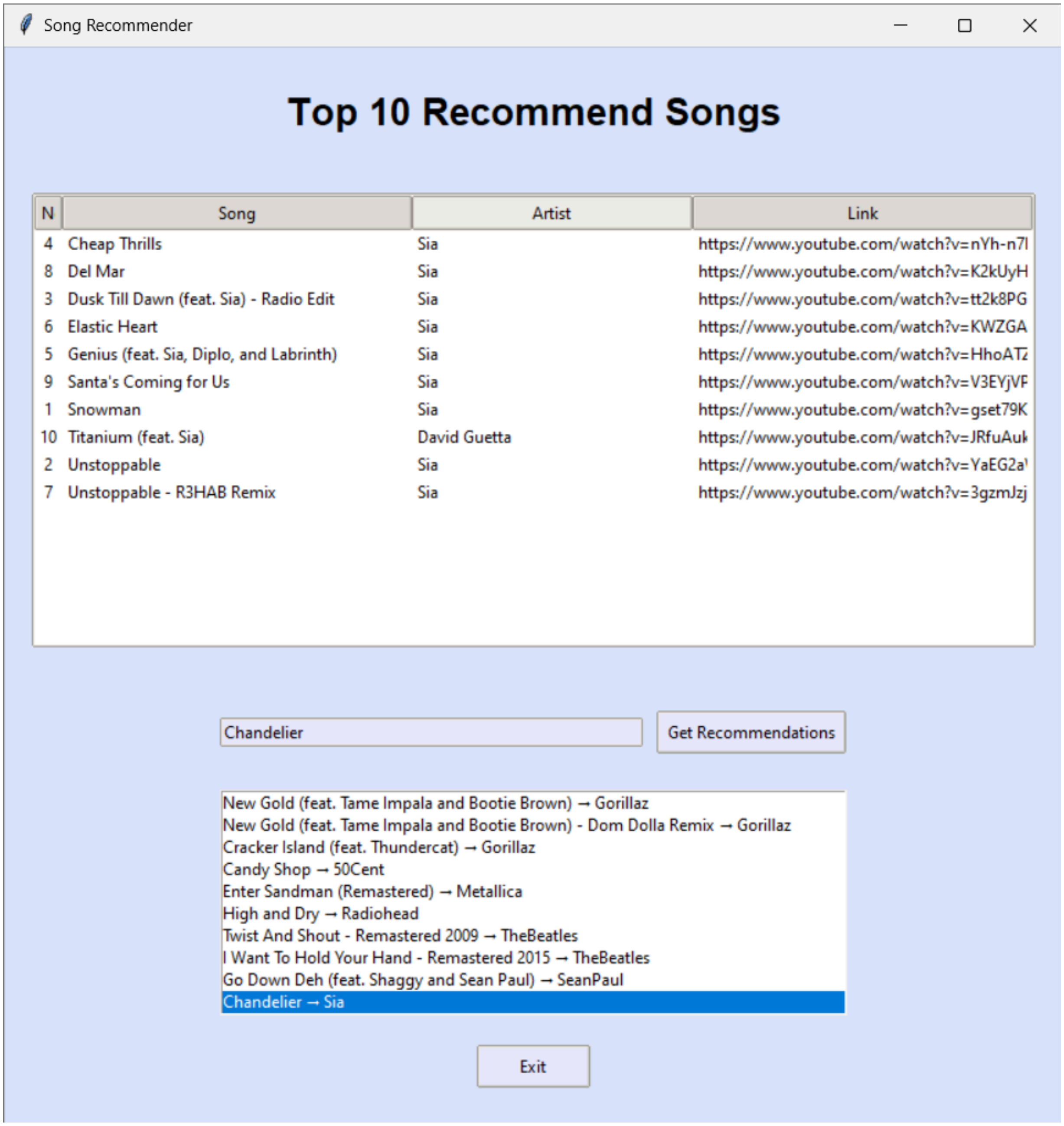


Top 10 Recommend Songs

Song not found in the database.

```
New Gold (feat. Tame Impala and Bootie Brown) → Gorillaz
New Gold (feat. Tame Impala and Bootie Brown) - Dom Dolla Remix → Gorillaz
Cracker Island (feat. Thundercat) → Gorillaz
Candy Shop → 50Cent
Enter Sandman (Remastered) → Metallica
High and Dry → Radiohead
Twist And Shout - Remastered 2009 → TheBeatles
I Want To Hold Your Hand - Remastered 2015 → TheBeatles
Go Down Deh (feat. Shaggy and Sean Paul) → SeanPaul
Chandelier → Sia
```

If a user enters a song name that is not in our dataset, the system will display an error screen.The user needs to click on “OK” to continue inputting the song.
This functionality is handled within the show_recommendations() method. If the entered song is not found in the database, the method detects this condition and displays an error message using the messagebox.showerror()



Top 10 Recommend Songs

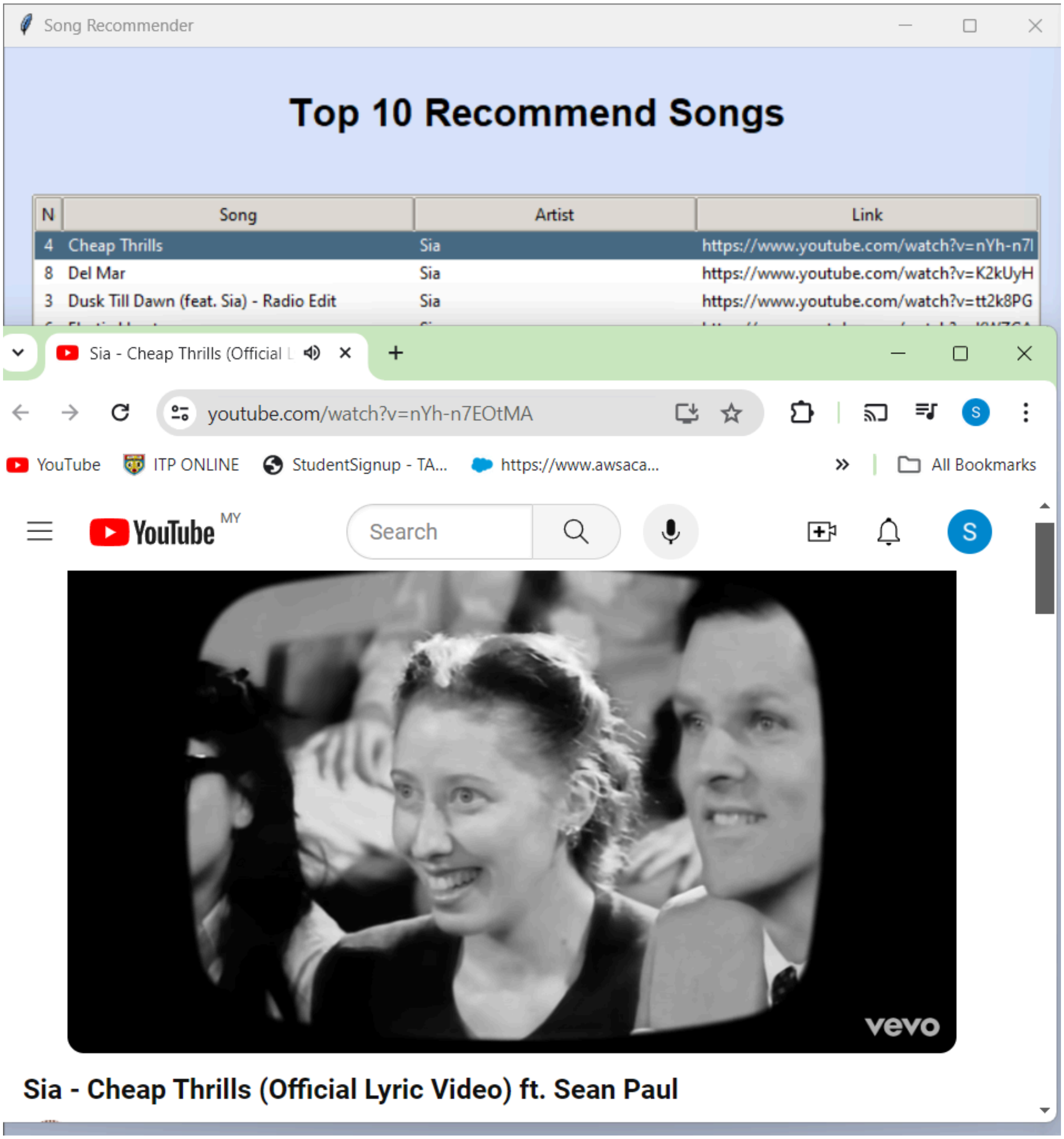
N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7l
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG
6	Elastic Heart	Sia	https://www.youtube.com/watch?v=KWZGA
5	Genius (feat. Sia, Diplo, and Labrinth)	Sia	https://www.youtube.com/watch?v=HhoATz
9	Santa's Coming for Us	Sia	https://www.youtube.com/watch?v=V3EYjVF
1	Snowman	Sia	https://www.youtube.com/watch?v=gset79K
10	Titanium (feat. Sia)	David Guetta	https://www.youtube.com/watch?v=JRfuAuk
2	Unstoppable	Sia	https://www.youtube.com/watch?v=YaEG2a'
7	Unstoppable - R3HAB Remix	Sia	https://www.youtube.com/watch?v=3gzmJzj

Chandelier

New Gold (feat. Tame Impala and Bootie Brown) → Gorillaz
New Gold (feat. Tame Impala and Bootie Brown) - Dom Dolla Remix → Gorillaz
Cracker Island (feat. Thundercat) → Gorillaz
Candy Shop → 50Cent
Enter Sandman (Remastered) → Metallica
High and Dry → Radiohead
Twist And Shout - Remastered 2009 → TheBeatles
I Want To Hold Your Hand - Remastered 2015 → TheBeatles
Go Down Deh (feat. Shaggy and Sean Paul) → SeanPaul
Chandelier → Sia

The sequence of songs can be sorted in ascending or descending order by clicking the header of the 'No', 'Song', or 'Artist' columns.

This sorting functionality is implemented within the sort_column() method. The method is bound to the column headers and is triggered when they are clicked. It sorts the recommendations displayed in the tree view based on the clicked column, either in ascending or descending order, depending on the current sorting state.



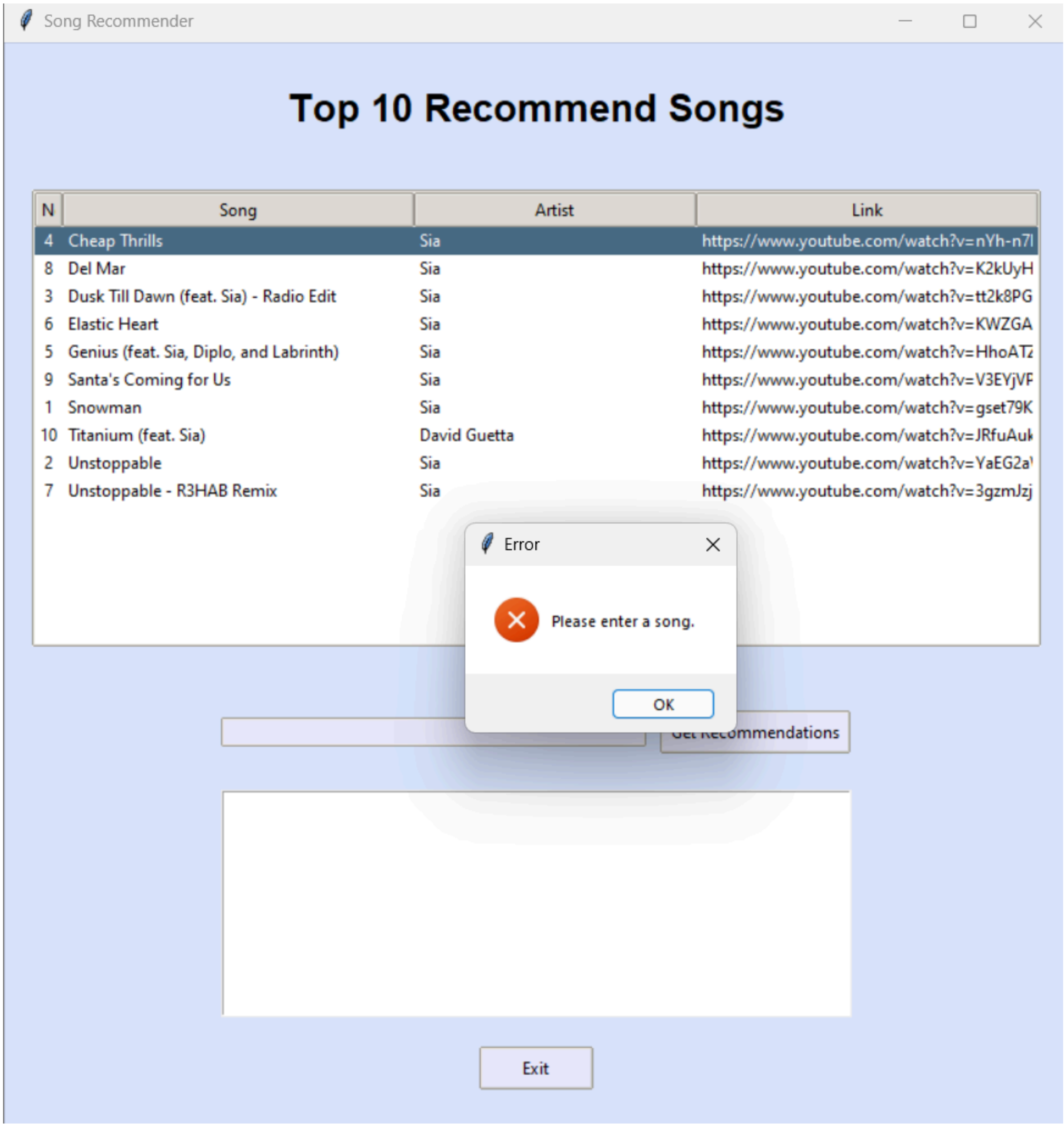
Song Recommender

Top 10 Recommend Songs

N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7I
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG

Sia - Cheap Thrills (Official Lyric Video) ft. Sean Paul

By clicking on the song link, the browser will open and navigate to YouTube to play the song. This functionality is achieved through the open_link() function, which takes the URL of the YouTube link as an argument. The function utilizes the webbrowser.open() method to open the link in a new browser window/tab (new=2).



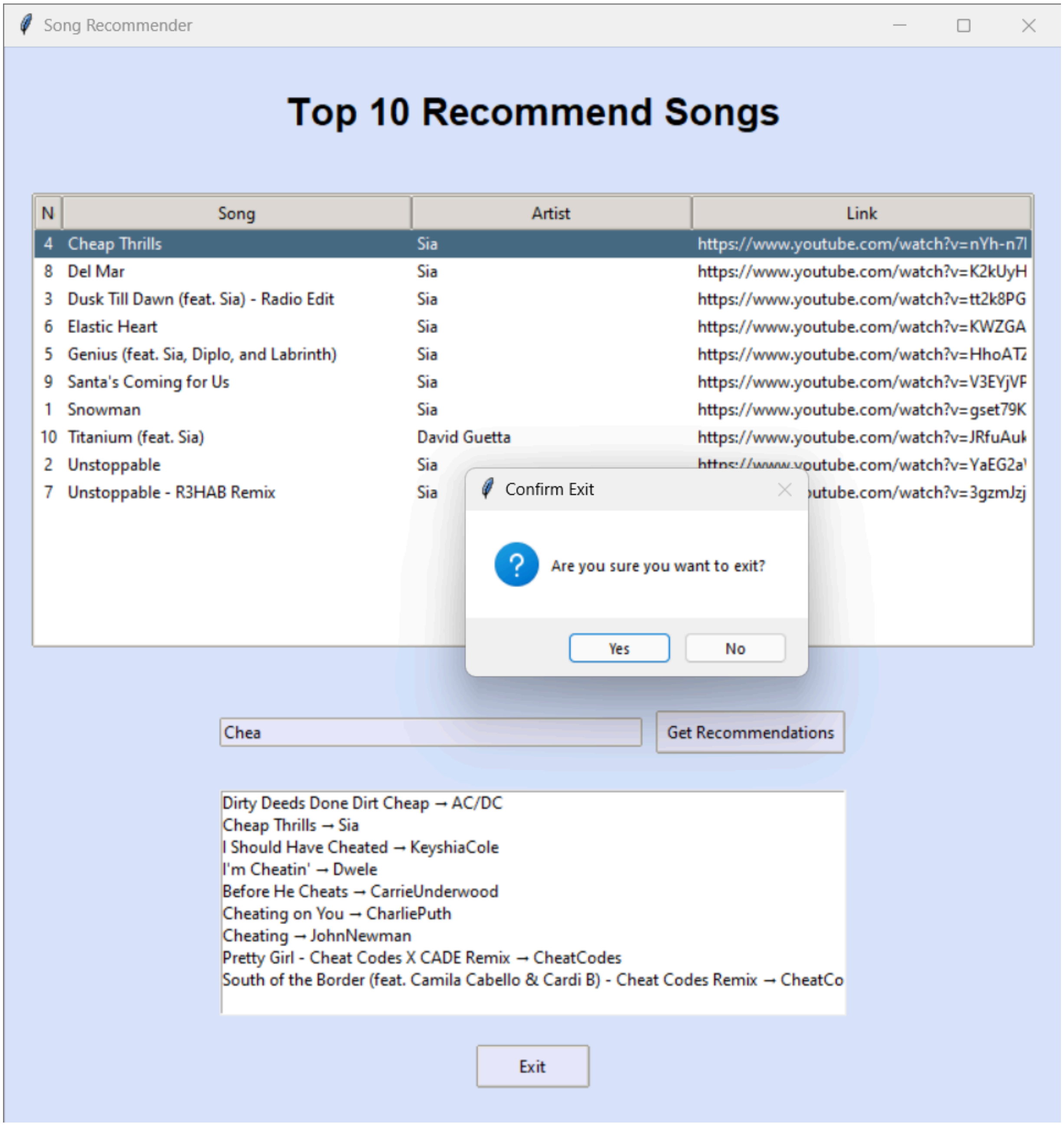
Top 10 Recommend Songs

N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7l
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG
6	Elastic Heart	Sia	https://www.youtube.com/watch?v=KWZGA
5	Genius (feat. Sia, Diplo, and Labrinth)	Sia	https://www.youtube.com/watch?v=HhoATz
9	Santa's Coming for Us	Sia	https://www.youtube.com/watch?v=V3EYjVF
1	Snowman	Sia	https://www.youtube.com/watch?v=gset79K
10	Titanium (feat. Sia)	David Guetta	https://www.youtube.com/watch?v=JRfuAuk
2	Unstoppable	Sia	https://www.youtube.com/watch?v=YaEG2a
7	Unstoppable - R3HAB Remix	Sia	https://www.youtube.com/watch?v=3gzmJzj

Please enter a song.

If a user enters an empty input,it will prompt an error that asks the user to enter a song.The user needs to click on “OK” to continue inputting the song.

This functionality is handled within the show_recommendations() method. If the input field is empty when the user tries to get recommendations, the method detects this condition and displays an error message using the messagebox.showerror() function, informing the user to enter a song before proceeding to get recommendations.



Top 10 Recommend Songs

N	Song	Artist	Link
4	Cheap Thrills	Sia	https://www.youtube.com/watch?v=nYh-n7l
8	Del Mar	Sia	https://www.youtube.com/watch?v=K2kUyH
3	Dusk Till Dawn (feat. Sia) - Radio Edit	Sia	https://www.youtube.com/watch?v=tt2k8PG
6	Elastic Heart	Sia	https://www.youtube.com/watch?v=KWZGA
5	Genius (feat. Sia, Diplo, and Labrinth)	Sia	https://www.youtube.com/watch?v=HhoATz
9	Santa's Coming for Us	Sia	https://www.youtube.com/watch?v=V3EYjVF
1	Snowman	Sia	https://www.youtube.com/watch?v=gset79K
10	Titanium (feat. Sia)	David Guetta	https://www.youtube.com/watch?v=JRfuAuk
2	Unstoppable	Sia	https://www.youtube.com/watch?v=YaEG2a
7	Unstoppable - R3HAB Remix	Sia	utube.com/watch?v=3gzmJzj

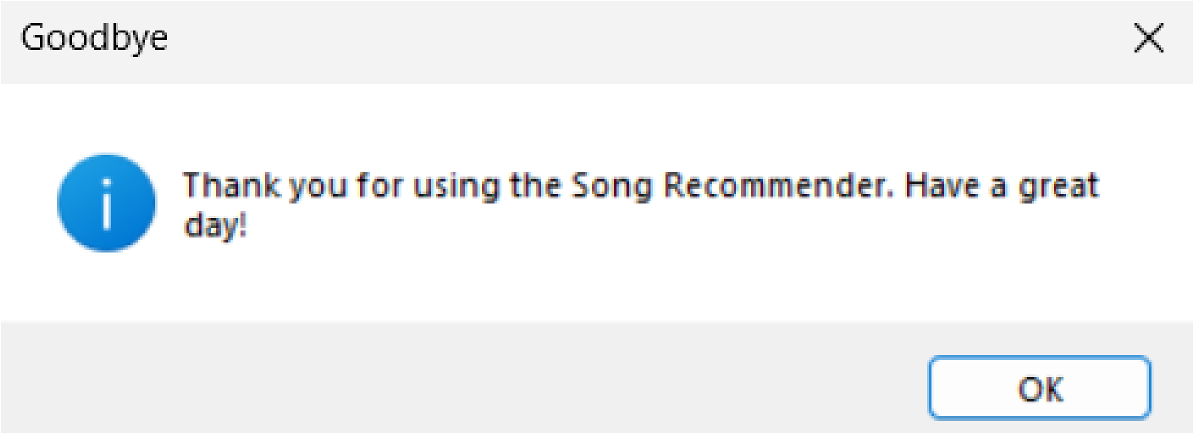
Are you sure you want to exit?

Chea

Dirty Deeds Done Dirt Cheap → AC/DC
Cheap Thrills → Sia
I Should Have Cheated → KeyshiaCole
I'm Cheatin' → Dwele
Before He Cheats → CarrieUnderwood
Cheating on You → CharliePuth
Cheating → JohnNewman
Pretty Girl - Cheat Codes X CADE Remix → CheatCodes
South of the Border (feat. Camila Cabello & Cardi B) - Cheat Codes Remix → CheatCo

If the user clicks the 'X' button at the top right of the window or the 'Exit' button, a confirmation message will appear. If you select the 'No' option, you will remain in the system.

This functionality is implemented within the confirm_exit() function, which is bound to the "Exit" button and the close button of the application window (root.protocol("WM_DELETE_WINDOW", confirm_exit)). The function utilizes the messagebox.askyesno() function to display the confirmation dialog and checks the user's response to determine whether to proceed with the exit operation.


Goodbye

Thank you for using the Song Recommender. Have a great day!

"After clicking the 'Yes' option, the system will display a 'Goodbye' screen.
This functionality is handled within the goodbye_message() function, which is called after the application window is destroyed. The function utilizes the messagebox.showinfo() function to display the goodbye message to the user.

5. Discussion and Conclusion

5.1. Achievements

The project, which is a song recommendation system, has successfully achieved significant milestones in enhancing user satisfaction, fostering song exploration, reducing decision fatigue, continuously learning and adapting, and creating a user-centric platform.

First of all,the system is able to enhance user satisfaction by providing the user with personalized and relevant song recommendations based on their input song.In this situation,the system is able to increase the user's enjoyment and engagement while introducing users to new artists and songs based on their preference.This not only can enhance the satisfaction of user but also achieve the others objective which is fostering song exploration, reducing decision fatigue.This is because the users is able to get into the new different type of song by using the song recommendation system.In this case,they can fostering song exploration easily based on their preferences.Beside,the objective of reducing decision fatigue can be achieve by using the song recommendation system as user can get the recommendation song base on their taste without going and searching the song one by one on internet as the system will provide the song, artist and the song’s link that can let user enjoy the song by just one click.

By streamlining the song discovery process and continuously evolving its recommendation algorithms, the system will ensure that recommendations remain up-to-date and reflective of individual musical interests over time. Overall, the project has successfully created a user-centric platform that maximizes user engagement and enjoyment of song content, establishing a foundation for long-term user loyalty and satisfaction.

5.2. Limitations and Future Works

The first limitation of the song recommendation system is it heavily relies on the text data, specifically the song names and artist names. This might limit its effectiveness in recommending instrumental songs or genres which have lyrics that are not prominent. For example, some songs might be instrumental, in a language which are not supported by the system, or have minimal text content. Moreover, the recommendation results is relatively poor, since it can only recommend songs based on editorial metadata and none of the users' information has been considered (Song et al., 2012). Integrating user information into the recommendation system is essential for enhancing the relevance, diversity and user satisfaction of the recommendations. Besides that, the representation of the system is limited as it represents songs based solely on their titles and artists and will neglect other significant factors such as genre, tempo, mood or instrumentation. Hence, this can lead to recommendations that lack diversity and fail to capture the subtlety of different song preferences. In addition, the system provides limited contextual understanding about user preferences, listening history, ratings about the songs themselves. Without this contextual understanding, it may be difficult to suggest personalized recommendations that are customized to individual users' favor and moods.

To address the limitations of the song recommendation system, the first improvement can be made is to expand the feature set used for recommendation not only on song titles and artist names. It can include more metadata such as genre, tempo, mood, instrumentation and language. Therefore, it can offer more understanding of songs and improve recommendation accuracy, especially for instrumental music or songs with minimal text content. Second, the system can implement advanced content-based filtering techniques that analyze audio features including melody, rhythm and timbre. As a result, it can overcome the limitations of relying solely on text data and provide more accurate recommendations, especially for instrumental or non-lyrical music. Furthermore, we plan to assess the potential benefit of user profiling by explicitly given preference examples in form of music tracks over more broad contextual categories (favorite artists, albums, genres, and even activities), and implicit information such as listening behavior statistics (Bogdanov et al., 2010). In addition, it can apply natural language processing(NLP) and audio analysis techniques to extract semantic meaning, sentiment and mood from song lyrics and audio features. By understanding the emotional content and thematic elements of songs, the system can recommend the songs that align with the user's mood and preferences.

Reference & Source

Sources of the dataset: https://www.kaggle.com/code/aryaupadhyay95/spotify-and-youtube-data-analysis/input

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https://spotintelligence.com/2023/05/17/countvectorizer/#:~:text=CountVectorizer%20is%20a%20text%20preprocessing,machine%20learning%20library%20in%20Python.