Multi-Model Approach to Recommend Personalized Music Playlist

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Project Proposal Report

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1. DECLARATION

I hereby declare that the work presented in this proposal is entirely my own and has been conducted under my initiative and supervision. This proposal does not incorporate, without proper acknowledgment, any material that has been previously submitted for a degree or diploma in any other university or institute of higher learning. To the best of my knowledge and belief, this proposal does not contain any material that has been previously published or written by another person, except where explicit acknowledgment is made within the text. I take full responsibility for the originality and authenticity of the content presented in this proposal. Any sources, ideas, or contributions from external individuals or works have been appropriately cited and referenced.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

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2. ABSTRACT

The proposed project aims to provide a personalized experience to the user through a "music recommendation based on the user's surroundings" application. This application is developed using ML and image processing. With the user's context-aware approach, the user can ignore the human body parts in the selfie image the user uploads, understand the surrounding data of the image, and consider in real-time a song that is best suited for the situation. This is expected to increase user satisfaction. Traditional music is interested in emotion but ignores ambiance. The app analyses the user's surroundings and creates an innovative system that follows in real time to recommend the best songs for the occasion. The data is trained using a convolutional neural network (CNN) model to detect surrounding data. Here the surrounding times are compared with colors, weather conditions, indoor/outdoor detection, etc. This application can be used as a digital tool that can be used without any age limit.

Keywords: music recommendation, surroundings, context-aware, image processing, convolutional neural network (CNN), ML

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LIST OF ABBREVIATIONS

List of Abbreviations	Description
CNN	Convolutional Neural Network
ML	Machine Learning
HCI	Human-computer interaction

4. INTRODUCTION

4.1 Background

"Music recommendations based on the user's environment" are mainly expected to analyze the data of the environment and provide a personalized experience to recommend the most suitable songs for the occasion. Nowadays, with the development of technology, the performance of social recommendation systems on the rapidly evolving digital social platform has become more efficient. Existing music recommendation systems often ignore the user's immediate surroundings and environmental conditions when recommending songs. But when the emotions are connected with this environment, the mental state is better [4]. Through platforms like Spotify, iTunes, and YouTube, we have to find music recommendations from the user himself. But this app detects the surrounding weather, whether inside or outside, time and place of the station [3]. By entering the surrounding data using image processing and analyzing the stored surrounding data in CNN format [2], it presents the most suitable and best music recommendations for the occasion. Currently, most of the existing research is focused on emotion [5]. We hope to provide a better output to the user by paying attention to the surroundings of this application.

4.2 Literature Survey

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In the paper [5], the authors used the webcam to train input images to recognize features and recognize facial emotions, and after these faces are recognized, feature extraction is performed. The mobile applications of the applied system improve the features to ignore the facial expressions in the picture and recognize the surroundings. The CNN algorithm is used for music recommendation. [2] Train human-computer interaction (HCI) to recognize facial emotions. These apps are trained to store sensitive data like ambient conditions, indoor/outdoor temperature, time, status, etc. To this end, the new system works to provide a personalized experience [4] by using scene analysis [11] to find the most appropriate music

recommendation. For the proposed application, this experiment follows research [10] that can detect changes in the sun to understand weather conditions. System quality and new features are improved by obtaining time and status information [3]. The tendency to judge mood has been used in image processing based on facial expressions [1]. Using image processing, the app presents suggested songs around the image, which is used to recommend songs based on their surroundings. The design of this system needs further research based on its surroundings, but the results of past studies are encouraging.

4.3 Research Gap

This component differs from other existing studies because it mainly focuses on the user's surroundings. That is because, despite the research that currently suggests music for human emotions and moods, there are no song recommendations that match the real-time environment. This app is organized to support both Android and iOS platforms. Mainly, the surrounding weather conditions, times, environmental color changes, etc. can be obtained in one application. An impressive user-friendly application.

Feature	**Research 01**	**Research 02**	**Research 03**	**Research 04**	**Propose System**
Image Processing	✓	✓	✓	✗	✓
Convolutional neural network (CNN)	✗	✓	✗	✓	✓
Capture Weather & indoor or outdoor	✗	✗	✗	✗	✓
Capture the Time & Place	✗	✗	✓	✗	✓
Music Recommendation	✓	✓	✓	✓	✓
Mobile Solution	✓	✗	✗	✓	✓
Detect specific objects or elements	✗	✗	✗	✗	✓
Monitoring by Multiple Users	✓	✓	✓	✓	✓

Table 1: Research Gap

4.4 Research Problem

The research problem of the necessity of technical intervention is due to various reasons; currently, most of the research is based on emotion-based music recommendation systems [5], but research is not based on the characteristics of the environment. The main problem for research in the proposed method is that understanding meteorological conditions is a research problem. [10] Although research is based on variations in the sun, research on other meteorological conditions is to be done. According to the characteristics of the user's environment, whether it is indoor or outdoor, the CNN model is used to train the system, and the data [2] has to be studied. The research problem [9] arises from real-time song recommendations based on the environment. Music collection discovery [7], [4], and [6] requires gathering data from diverse demographics to provide a personalized experience and recommend the most appropriate song. However, based on these environmental characteristics, a music recommendation system using image processing has not been mentioned in the same way.

5 OBJECTIVES

5.1 Main Objective

The main objective of the research is to develop a mobile application that supports multiple platforms, such as Android and iOS, with better and more effective screening and refinement methods to recognize the user's surroundings and personalize the best song recommendations by avoiding age, mood, and environmental stress. is to provide. User-friendly regardless of age...

5.2 Specific Objectives

Image Analysis and Context Detection:

- Developing an accurate algorithm for analyzing user's surroundings using selfie images, detecting contextual elements like time, indoor/outdoor settings, and weather conditions, and predicting music preferences.

Feature Extraction:

- Algorithms extract key features from images to accurately determine user context using lighting conditions, objects, and color tones.

Context-Dependent Music Preference Modeling:

- Context-aware music recommendation models built on user surroundings and preferences.

Real-time Contextual Data Integration:

- An efficient system integrates real-time contextual data with a music recommendation engine.

6 PROJECT REQUIREMENTS

6.1 Functional Requirements

It is essential to recommend more suitable songs based on the user's environment. It aims to identify the necessary data and provide a personalized experience. Functional requirements should include information such as recognizing the environment using image processing and weather conditions.

1. Users can easily insert images and perform image processing and acoustic analysis.
2. Ability to recognize weather conditions, time, indoors and outdoors.
3. Capability of real-time data processing.
4. Ability to suggest the right song recommendations.
5. Capability of Context-Aware Music Recommendations

The functional requirements of the mobile app should prioritize accuracy, reliability, and ease of use and ensure that the app recommends songs to stressed people after analyzing their emotions and surroundings to make the user feel better.

6.2 Non-Functional Requirements

Non-functional requirements are limitations or attributes that a software system must have but that do not perform a specific function. In the context of a mobile application, non-functional requirements may include:

6. Usability: The application should be user-friendly and intuitive to navigate, allowing users to use it without typing.
7. Security: The app should protect sensitive data such as photos and locations, to ensure the privacy of the users.
8. Performance: The system should generate music recommendations within 3 to 8 seconds of receiving user input.
9. Scalability: The system should be able to handle a user base of at least 1000 users without significant degradation in performance.
10. Reliability: Data loss or corruption should not occur during downtime.

These non-functional requirements are critical for the success and acceptance of the mobile app for identification.

7 METHODOLOGY

The methodology for the proposed Multi-model music recommender system that enhances the personalized experience of the user is mentioned below. Some tools and technologies are going to be used for the implementation of the system.

Algorithms

- CNN
- RCNN
- ANN

(Selection of the algorithms can differ during the implementation based on the best approach)

Integrated development environment (IDE)

- PyCharm or Anaconda

Databases

- MongoDB
- Firebase

Backend

- Image Processing
- Image Analysis
- Feature Extraction
- Python - handle algorithms OpenCV framework

Overall, the above process includes data collection, data preprocessing, implementing a machine learning model, testing, and training the model, deploying the system, maintenance, and updates for the improvement of the system's performance. The system's success depends on the quality and quantity of data used to train the model, the accuracy and reliability of the machine learning algorithms, and the effectiveness of the system in classifying user details.

7.1 System Architecture

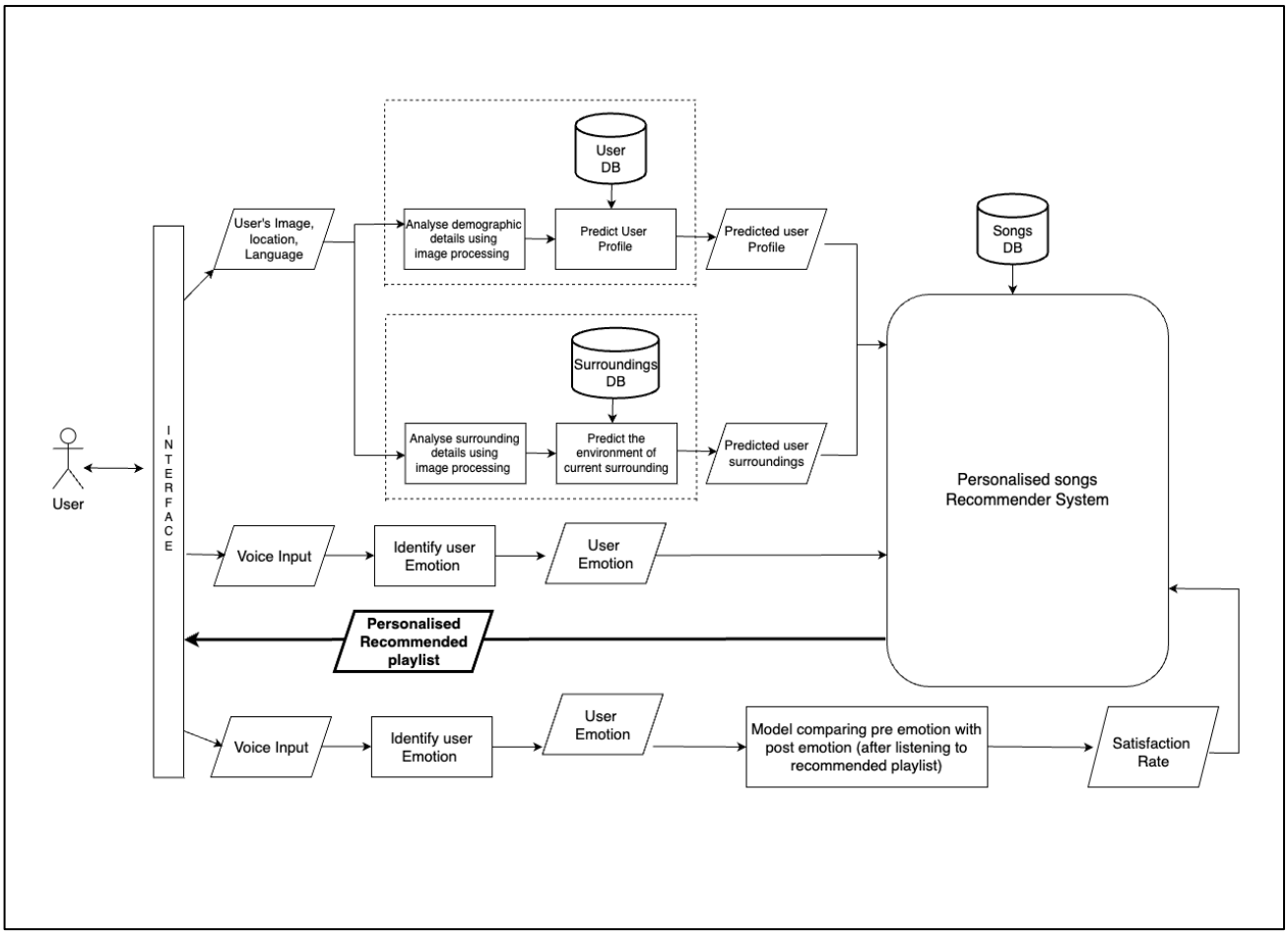

Figure 1: Overall System Diagram

7.2 System Work Breakdown Architecture

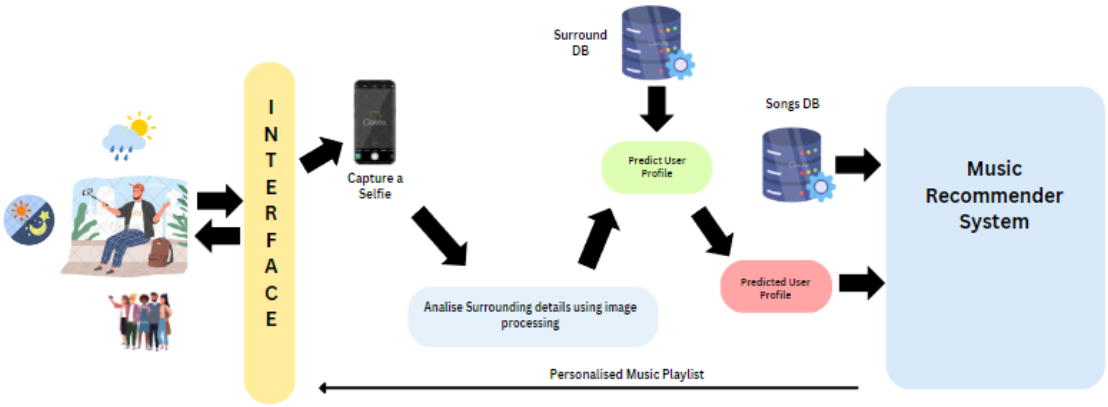

Figure 2: Individual System Diagram

7.3 Work Breakdown Chart

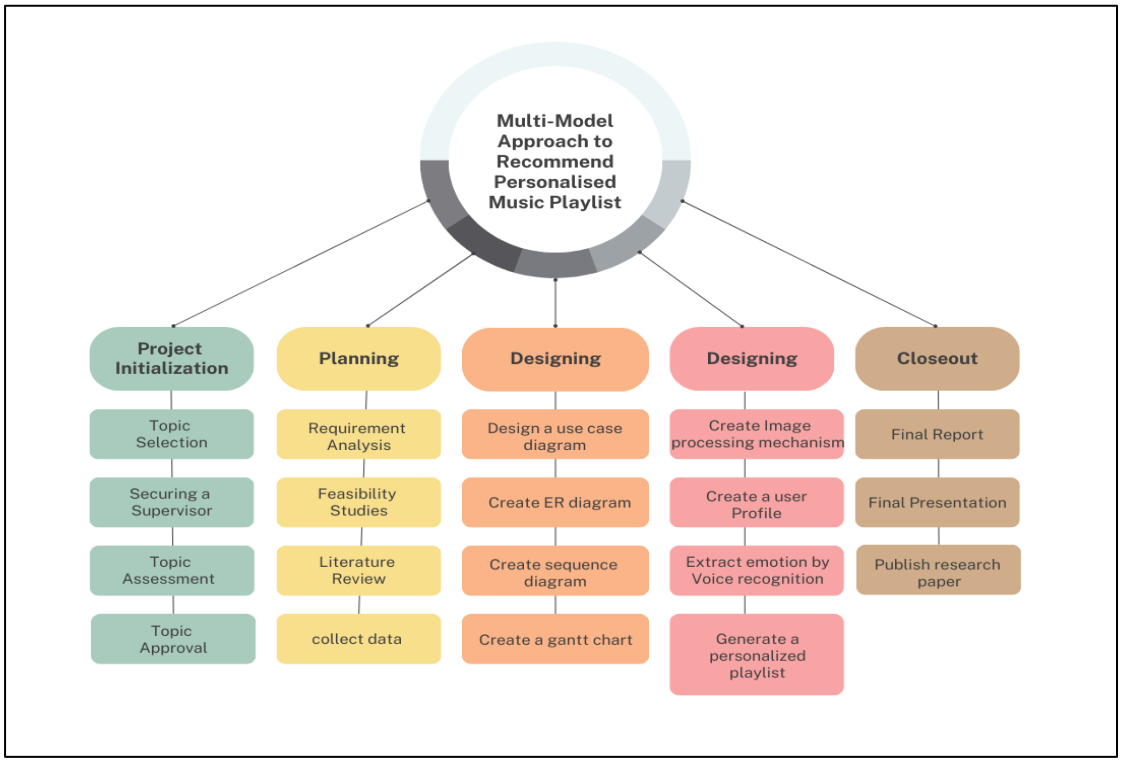

Figure 3: Work Breakdown

7.4 Grant Chart

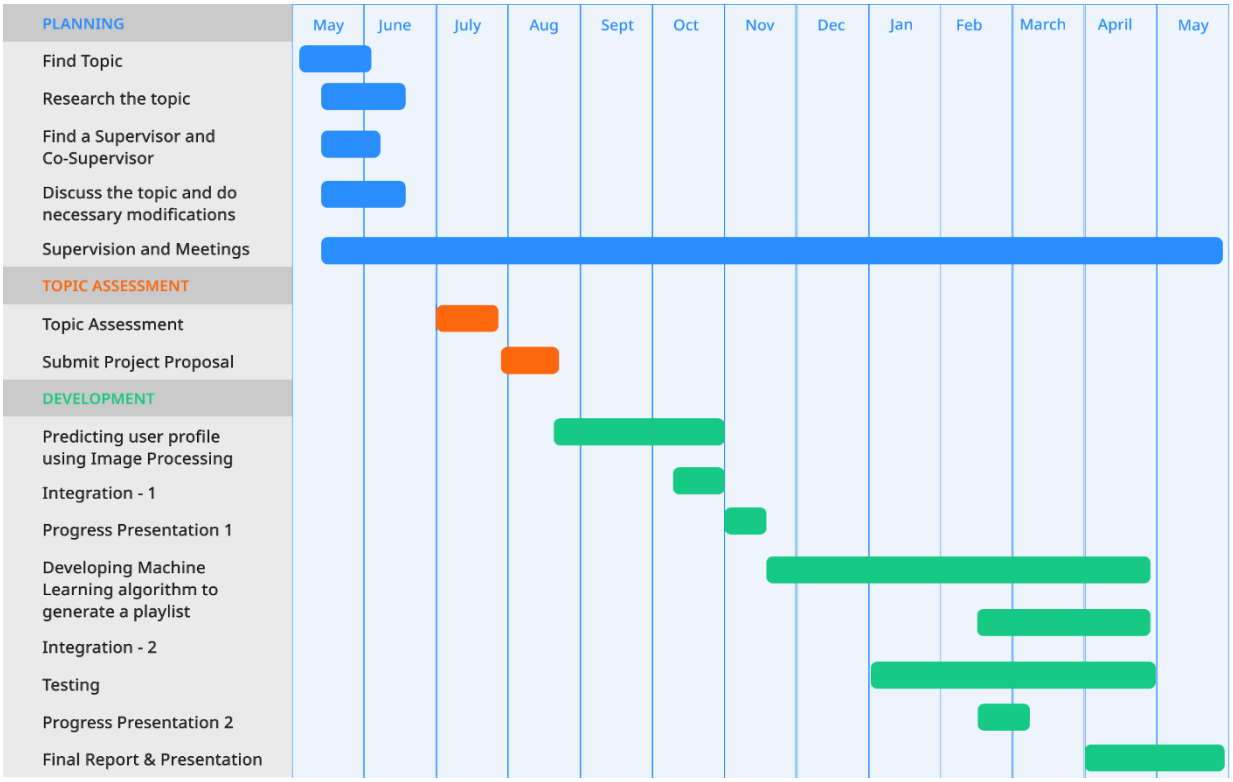

Figure 4: Grant Chart

7.5 Data collection

- Environmental Data Collection:

  The app collects user data on weather conditions and location using the Weather API, capturing geographic coordinates and reporting current time for time-based preferences.

- User Preferences and Listening Behaviour

  Collect user data on music preferences, listening history, and interactions to understand taste, refine the recommendation engine, and record preferences for genres, artists, and moods.

- Image Data for Surrounding Visualization:

  Collect visual data to represent the user environment, enhance the recommendation process through image capture and processing, and extract relevant features like lighting, scenery, and weather.

- User Contextual Data:

  Record contextual information about the user's environment, including indoor/outdoor context and activity level, to influence music preferences.

8 LIMITATIONS AND CHALLENGES

8.1 Limitations

- Accurate real-time user data gathering challenges due to availability, coverage, and reliability issues.
- Environmental conditions impact musical preferences subjectively and can vary among individuals.
- Privacy concerns arise from user location data inference
- Ambient and music preferences correlations may vary among users, limiting recommendations.
- Users' preferences evolve, necessitating continuous adaptation of recommendation models
- Improperly correlated weather and music preferences can result in inaccurate recommendations.

8.2 Challenges

- Real-time data acquisition and data variety integration require consistency and compatibility for accurate recommendations.
- The subjective nature of music preferences is influenced by environmental conditions and multi-context influence, challenging to disentangle from individual preferences.

- Users' diverse preferences challenge single recommendation models; evolving preferences require adaptive models to accommodate changing tastes.
- Modeling music preferences accurately and identifying relevant features from environmental data is challenging.
- Real-time data processing strains computational infrastructure.

9 TEST PLAN

Optimum Music mobile application testing involves multiple stages to ensure early bug detection and resolution, improving system robustness and usability. Music recommendations are based on user surroundings.

9.1 Unit Testing

Researchers will conduct unit testing for image classification and music recommendation models, identifying and fixing bugs in each component. The focus will be on two main aspects.

a) Performance testing of the component.
   - Evaluate the image classification model's processing time across various image sizes.

b) Accuracy testing of the component.
   - The verification model correctly classifies images within an acceptable time frame.

9.2 Integration Testing

This research project focuses on component integration, testing them individually and simultaneously to prevent system bugs and ensure system stability.

9.3 Final Testing

Final testing will ensure the system's performance without issues using various test cases and sample data. In the second phase, beta users will provide feedback on the mobile application. The user experience will be measured, and researchers will refine the app's interface to enhance the end-user experience.

10 BUDGET AND COMMERCIALIZATION

As music players are used daily by people this project can have a huge commercial value. People are willing to pay a fair amount for a better music player. As there are some market leaders like Spotify, Apple Music, and Deezer available, the price of the music player must be competitive and fair. Almost every (Spotify, Apple Music, and Deezer) player costs approximately $10 per month. Some people find it expensive and not worth enough to buy that subscription model, Therefore the below subscription model is proposed for the commercialization of this mobile app,

Mainly this app will be available in the major app stores such as Google Play Store, Apple AppStore, and Huawei App Gallery. There will be two models for this mobile,

	Free version	**Paid version (<$10/month)**
Advertisements	Yes Advertisement networks such as Google Adsense /Admob will run on this version of the mobile app	No No advertisements will be displayed in the mobile app
Monthly charges for the users.	No Revenue will be generated from the advertisements shown to the user while the user is using the mobile application.	Yes Revenue will be generated from the monthly charges paid by the user.
Features	All features	All features

Table 2: Subscription Type

The final mobile application will be focused on different user groups; therefore, it will be marketed to each user group using different methods,

1. The younger generation – Social media advertisements (Facebook/Instagram)
2. Mature generation – Newspapers etc.
3. Musical experts – Face-to-face demonstrations with musical associations/groups.

Below is the budget that has been planned for the project, Charges will be changed according to time to time, and final charges will be based on the consumption of the resource used in the cloud environment

Description	Amount (USD)
1. AWS Cloud database (S3) for facial images • To store user images collected through the mobile app.	0.023 per GB / Month
2. AWS Cloud database (EFS) for user demographic data. • To store the demographic data of the users.	0.30 per GB / Month
3. AWS Glacier to store User logging from the mobile application.	Storing = $0.004 per GB / Month Retrieving = $0.01 per GB
4. Paper Publications and Documentation.	

Table 3: Budget Plan

11 REFERENCES

1) O. Ghosh, R. Sonkusare, S. Kulkarni and S. Laddha, "Music Recommendation System based on Emotion Detection using Image Processing and Deep Networks," 2022 2nd International Conference on Intelligent Technologies (CONIT), Hubli, India, 2022, pp. 1-5, doi: 10.1109/CONIT55038.2022.9847888.

2.) S. Pesaru, K. Sucharitha, R. Lahari and P. Prakash, "Music Recommedation System Using CNN Algorithm," 2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICICT), Kannur, India, 2022, pp. 1827-1829, doi: 10.1109/ICICICT54557.2022.9917811.

3.) J. G. B. Vitório and C. N. Silla, "Music Recommendation System for Shared Environments," 2023 30th International Conference on Systems, Signals and Image Processing (IWSSIP), Ohrid, North Macedonia, 2023, pp. 1-5, doi: 10.1109/IWSSIP58668.2023.10180270.

4.)Dorochowicz, Aleksandra & Kostek, Bozena. (2019). Relationship between album cover design and music genres. 93-98. 10.23919/SPA.2019.8936738

5.) H. S. Angkasa and N. U. Maulidevi, "Emotion Classification of User Face Image in Music Recommendation System," 2022 9th International Conference on Advanced Informatics: Concepts, Theory and Applications (ICAICTA), Tokoname, Japan, 2022, pp. 1-6, doi: 10.1109/ICAICTA56449.2022.9933010.

6.) Use IEEE reVerma, Varsha & Marathe, Ninad & Sanghavi, Parth & Nitnaware, Dr. (2021). Music ecommendation System Using Machine Learning. International Journal of Scientific Research in Computer Science, Engineering and Information Technology. 80-88. 10.32628/CSEIT217615.erencing format

7))Lee, J. H., & Kim, S. W. (2019). Emotional Music Recommendation System Using Audio Content and Lyrics. IEEE Transactions on Multimedia, 21(5), 1181-1191.

8) S. Sasaki, T. Hirai, H. Ohya and S. Morishima, "Affective Music Recommendation System Reflecting the Mood of Input Image," 2013 International Conference on Culture and Computing, Kyoto, Japan, 2013, pp. 153-154, doi: 10.1109/CultureComputing.2013.42.

9) B. Zhai, B. Tang and S. Cao, "Music Recommendation System Based on Real-Time Emotion Analysis," 2022 International Conference on Culture-Oriented Science and Technology (CoST), Lanzhou, China, 2022, pp. 334-338, doi: 10.1109/CoST57098.2022.00075.

10)Y. Sato and K. Ikeuchi, "Reflectance analysis under solar illumination," Proceedings of the Workshop on Physics-Based Modeling in Computer Vision, Cambridge, MA, USA, 1995, pp. 180-187, doi: 10.1109/PBMCV.1995.514684.

11)Johnson, M., White, E. (2019). "Analyzing Image Texture for Scene Classification." Proceedings of the IEEE International Conference on Computer Vision, 789-802. DOI:

12 APPENDIX

12.1 Plagiarism Test

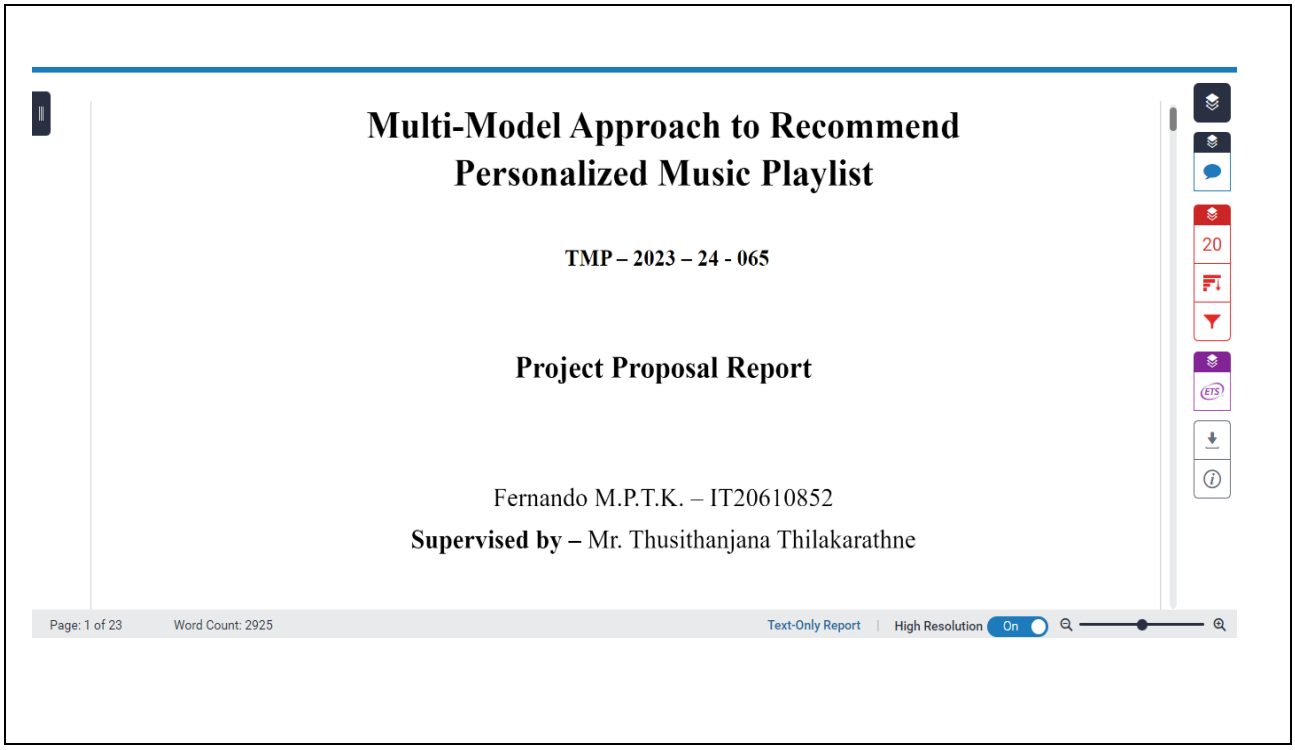

Figure 5: Plagiarism Report