A Mini Project Synopsis on

iFeels: Music recommendation using facial expression

T.E. – Computer Science and Engineering-Data Science

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CERTIFICATE

This to certify that the Mini Project report on **iFeels: Music recommendation using facial expression** has been submitted by Arya Patil(21107009), Faizan Mahimkar(21107007), Harshal Patil(21107060) and Himanshu Maurya(21107038) who are a Bonafide students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfillment of the requirement for the degree in **Computer Science and Engineering(Data Science)**, during the academic year **2022-2023** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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Chapter 1

Introduction

The "Real-Time Emotion-Based Music Recommendation Web Application" is an innovative and user-centric project aimed at enhancing the music listening experience. In today's digital age, music is a ubiquitous part of our lives, and personalized recommendations have become essential for users to discover and enjoy their favorite tunes. This project seeks to bridge the gap between music and emotions, creating a seamless connection that allows users to find the perfect soundtrack for their mood instantaneously.

The primary objective of this project is to leverage cutting-edge technology, including and machine learning algorithms, to accurately detect and interpret user emotions. By analyzing text or secondary inputs in real-time, we aim to provide personalized music recommendations that align with the user's emotional state, whether they're feeling happy, sad, energetic, relaxed, or any other emotion in between. This emotional intelligence in music recommendation will ensure a more immediate and relevant music experience, creating a deeper emotional connection between users and their playlists.

1.1 Purpose:

The purpose of this project is to address the ever-growing demand for a more personalized and emotionally resonant music recommendation system. Music is an integral part of human life, influencing our emotions and experiences. Traditional music recommendation systems often fall short in delivering music that aligns with users' emotional states and contexts. Therefore, the primary purpose of this project is to create a Real-Time Emotion-Based Music Recommendation Web Application that not only recognizes users' emotions but also provides immediate and contextually relevant music suggestions.

To achieve this goal, our Real-Time Emotion-Based Music Recommendation Web Application will leverage cutting-edge technology, including machine learning algorithms and emotion recognition techniques. By incorporating user data and preferences, we aim to deliver a highly personalized music experience. This project also intends to ensure that music suggestions remain relevant as users' emotions and circumstances change throughout their listening journey. We are committed to offering a seamless and enjoyable user experience, fostering a deep emotional connection with music, and making it easier for users to discover new tracks that truly resonate with them. In essence, our project

aspires to bridge the gap between technology and human emotion, enhancing the way people interact with and enjoy music in the digital age.

1.2 Objective:

The primary objectives include developing a robust computer vision system capable of recognizing emotions through facial expressions, integrating KNN for accurate emotion classification, and implementing Haar cascades for facial feature detection. By achieving these objectives, the project seeks to create an emotion-based content recommendation system that enhances user experiences in applications ranging from personalized advertising to mental health support. The combination of OpenCV and ML algorithms will enable the seamless identification and response to user emotions, offering a dynamic and engaging user interaction.

- To recognize facial expressions.
- To create a music playlist using the facial data.
- To establish a robust and a comprehensive mapping between detected facial expressions and a range of emotional states and between recognized emotion and appropriate music genres respectively (Emotion-Music Mapping).
- To dynamically generate music recommendations by combining emotional cues with user preferences.
- To Facilitate User Feedback Mechanism and ensure continuous improvement of the recommendation algorithm.

1.3 Scope:

This project's applications extend across diverse domains. In healthcare, it can play a pivotal role in stress reduction and relaxation, offering personalized content recommendations to patients based on their emotional states, thereby improving their well-being. Additionally, it can infuse entertainment and interactivity into social gatherings, parties, and events by tailoring music and media to match the collective mood of attendees, enhancing the overall experience. In educational settings, the system can

assist students in maintaining focus and productivity by suggesting study music or calming content according to their emotional needs. Furthermore, it can serve as a valuable research platform for studying the intricate relationship between emotions and music preferences, yielding insights into human behavior and emotion. It can be a valuable asset for event planners looking to create memorable experiences at weddings, conferences, and other gatherings. Furthermore, it can aid individuals in their daily lives, providing a soundtrack that matches their emotions, from workouts to relaxation moments. The project's versatility and adaptability open doors to an array of possibilities, ultimately aiming to make music a more integral and harmonious part of people's lives in various contexts.

The scope of this project goes beyond these domains and has the potential to transform various other sectors as well. In the retail industry, our Real-Time Emotion-Based Music Recommendation Web Application can enhance the shopping experience by tailoring the in-store music to match the emotional states of customers, potentially increasing customer satisfaction and purchase decisions. In the realm of mental health and therapy, it can be a valuable tool for therapists to prescribe personalized music therapy to individuals dealing with various emotional and psychological challenges. Furthermore, it can be adapted for use in the gaming industry to create more immersive gaming experiences, where the music and soundtracks can dynamically change to align with the player's emotional responses, intensifying the gaming experience. The project's potential applications are vast, making it a versatile and innovative solution with far-reaching benefits.

Chapter 2

Problem Definition

Historically, music recommendation systems have primarily relied on user behavior, such as song history, likes, and dislikes, to generate personalized playlists. While these methods have been effective to some extent, they often lack the ability to capture the user's emotional state and provide music recommendations that align with their current mood or feelings.

In the present, ongoing methods have incorporated more advanced algorithms and machine learning techniques to improve music recommendations. However, they still rely heavily on user-generated data and lack the ability to directly interpret the user's emotional state in real-time. The disadvantages of previous methods become evident when considering their inability to adapt to a user's changing emotional state. Users may not always explicitly indicate their emotional state through their interactions with the system, leading to less accurate recommendations. Additionally, relying solely on user behavior data can result in recommendations that are influenced by past preferences but do not necessarily reflect the user's current feelings. By incorporating facial expressions, we aim to bridge this gap and create a music recommendation system that is more in tune with the user's emotions, providing a more enriching and personalized music listening experience.

Our proposed approach seeks to address this limitation by integrating facial expression analysis into the recommendation system. By utilizing computer vision and facial recognition technologies, we aim to detect and analyze the user's facial expressions as they interact with the system. These expressions can provide valuable insights into their emotional state, including happiness, sadness, excitement, or relaxation. We can then use this real-time emotional data to recommend music that matches their mood and emotional needs more accurately.

The problem at hand is to develop a Music Recommendation System that leverages Facial Recognition technology. In this era of digital music streaming, users often find themselves overwhelmed with an extensive catalog of songs and struggle to curate personalized playlists. Existing recommendation systems rely on user behavior and explicit preferences, which may not always reflect the user's mood or current state of mind. By integrating facial recognition technology, the project aims to create a novel approach to music recommendation by analyzing the user's facial expressions, gestures, or emotions in real-time. This system's primary objective is to accurately interpret the user's emotional state through their facial cues and recommend music that aligns with their current mood or activity, providing a more immersive and personalized music listening experience.

This project presents several challenges, including the need for robust facial recognition algorithms capable of accurately identifying and interpreting a wide range of emotions and expressions. Additionally, it involves the integration of the facial recognition technology with a music recommendation engine, which requires data processing and machine learning expertise. Moreover, ensuring user privacy and data security is crucial, as the system will be collecting and analyzing facial data. Therefore, this project must address these challenges to develop an effective and ethical Music Recommendation System using Facial Recognition technology that enhances the user's music discovery and listening experience.

Chapter 3

Proposed System

The proposed system for the "Music Recommendation System using Facial Recognition" project will be a cutting-edge application that seamlessly combines facial recognition technology with music recommendation algorithms. Users will interact with the system through a user-friendly interface, such as a mobile app or web platform, where they can grant access to their device's camera.

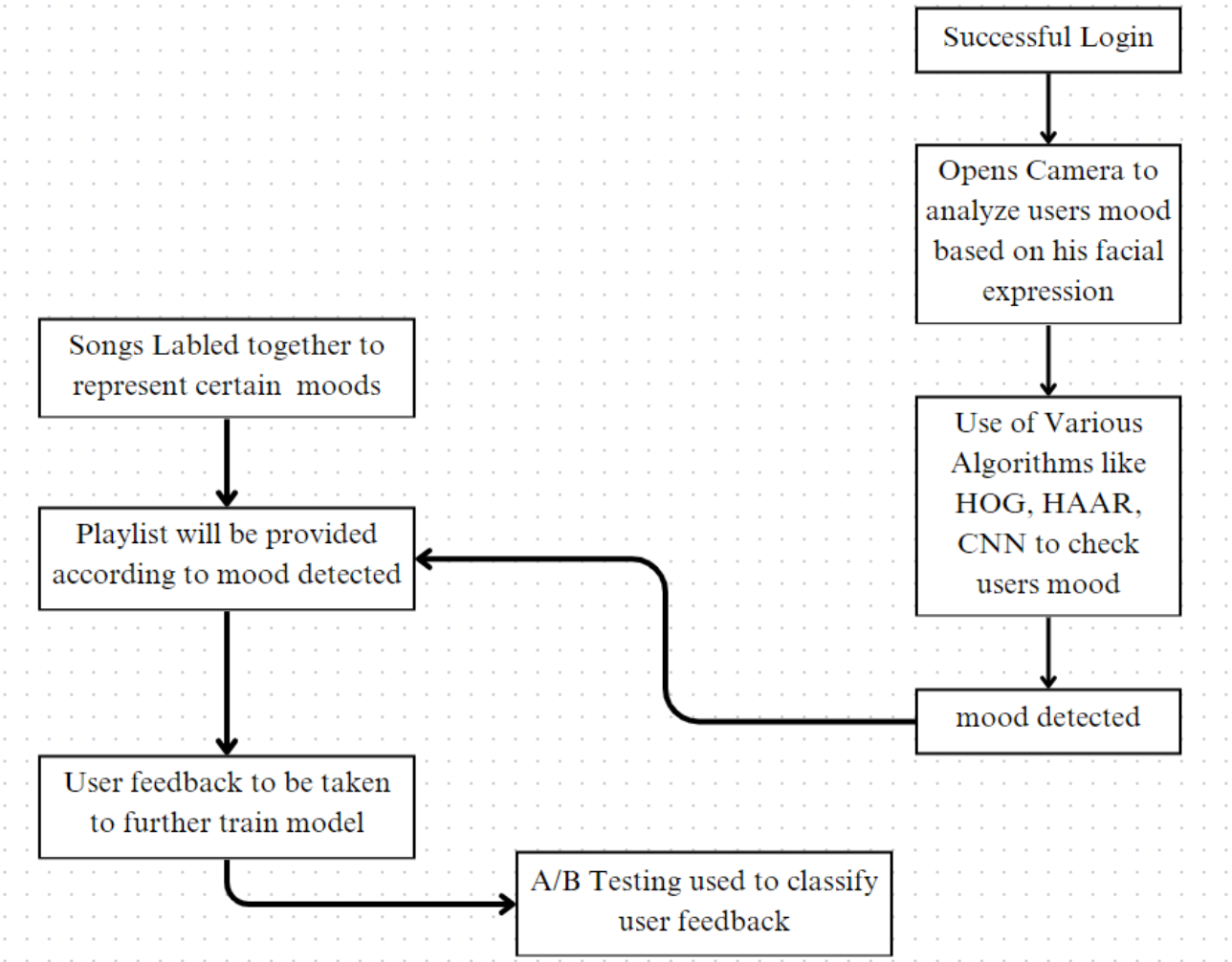
The system will continuously analyze the user's facial expressions and emotional cues in real-time, using advanced computer vision techniques to identify their current mood. Based on this analysis, the system will recommend music tracks from a vast library that best match the user's emotional state, creating a dynamic and personalized playlist.

3.1 Features & Functionality:

All users of the system, are required to first login to their accounts with their credentials and if a user is a new customer, he is required to create a new account. A detailed description is given for each activity which provides an overview of the activity of the iFeels(Music recommendation using facial expression)**.**

1. Real-time facial expression recognition: User needs to scan his face which is then converted to grey-scale and then the recognition works.
2. Real-time music recommendations: After the scanning the face and by recognizing the expression our algorithm will create a playlist to suggest it to the user.
3. User feedback: Here, the users can give their important, valuable feedback which then is read by the developer and future bugs, suggestions will be considered and respective responsive will be given.

3.2 System Diagram:



The project architecture is user-centered and begins with login, followed by facial expression analysis using various algorithms like HOG & HAAR. Mood detection guides the creation of mood-specific playlists, offering a personalized music experience. User feedback is collected to refine the mood detection model, and A/B testing is used to categorize feedback, ensuring continuous improvement. This iterative approach enhances the system's accuracy and emotional resonance over time.

Chapter 4

Project Outcome

A music recommendation system that utilizes facial expressions as a factor for generating personalized music recommendations can offer several noteworthy project outcomes. Here's an elaborate breakdown of these outcomes:

1. User-Friendly Interface:

   The user interface should be intuitive and visually appealing. It should prominently display recommended music and options, making it easy for users to interact with the system. A clean and user-friendly design is crucial to provide a positive user experience.

2. Input Options:

   The system captures and analyzes users' facial expressions in real-time through a camera or uploaded images to understand their emotions.

3. Display of Recommended Music:

   The recommended music is displayed clearly on the interface. Songs are categorized based on the detected emotions and user preferences. Each category may correspond to a specific genre or mood. This layout allows users to quickly identify and explore music that matches their current state.

4. Preview and Selection:

   Users can preview recommended music options directly on the interface. This could include short audio clips or song previews. Users can click on a song to listen to a sample, helping them decide whether they're interested in the song or not. This preview option is essential for user engagement.

5. Real-Time Facial Expression Detection:

   The system should be capable of recognizing and analyzing users' facial expressions in real-time. When a camera is used, the webcam feed can be displayed on the interface, with an overlay indicating the detected emotion. For uploaded images, the system should analyze the emotions in the images and display the results.

6. Emotion-Genre Mapping:

   The system should associate detected emotions with specific music genres. For example, if a user's facial expression indicates happiness, the system should recommend upbeat and cheerful music genres such as pop, rock, or dance. This mapping is essential for delivering emotionally resonant recommendations.

7. User Feedback and Customization:

   Users can provide feedback on recommended songs, helping the system to refine future suggestions. They may also have the option to customize their preferences and provide additional input, allowing the system to adapt to their evolving tastes and emotions over time.

8. Search and Explore:

   In addition to the recommended music, users should have the option to search for specific songs, artists, or genres. This allows for more user control and exploration beyond the system's recommendations.

9. User Profiles:

   The system can maintain user profiles that store historical data, including previous song selections, emotions, and preferences. Users can access their profiles to review their music history and preferences.

10. Privacy and Data Security:

    Ensure that users' privacy is protected, especially when using facial expression data. Clearly communicate how their data is used and stored, and allow users to control their data preferences.

Chapter 5

Software Requirements

To develop a Music Recommendation System using Facial Expression analysis, we need various software components and tools to build, deploy, and manage the system effectively. Here are the software requirements for the project:

1. Programming Languages:

   Python: The primary language for building the recommendation system and for machine learning and facial expression analysis.

2. Machine Learning and Data Analysis Libraries:

   - OpenCV: For real-time facial expression analysis and image processing.
   - TensorFlow or PyTorch: For developing and training machine learning models for emotion recognition.
   - Scikit-Learn: For machine learning tasks and data preprocessing.
   - Pandas and NumPy: For data manipulation and analysis.
   - Matplotlib and Seaborn: For data visualization.

3. Web Development:

   HTML, CSS, and JavaScript: For building the user interface and web-based interactions. Web Framework (e.g., Flask, Django): To create the web application for user interaction.

4. Database:

   Relational Database Management System (MySQL): To store user data, song information, and user preferences.

5. User Interface Framework:

   HTML, CSS, JS: To create a dynamic and responsive user interface for users to interact with the system.

6. Facial Expression Recognition API or Library:

Facial recognition libraries for capturing and analyzing facial expressions from images or real-time video streams.

7. Music Data and Integration:

   Music Streaming API (Shazam or Spotify): To access music catalog and metadata. Music Database: To store information about songs, genres, artists, and user preferences.

8. Authentication and Security:

   OAuth: For user authentication and authorization.

9. Version Control:

   Git: For collaborative development and version control.

10. Cloud Services:

    Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure: For hosting the application, machine learning models, and databases.

11. Development Tools:

    Integrated Development Environment (IDE): PyCharm, Visual Studio Code

    Database Management Tool (MySQL): For database administration.

12. Documentation Tools (Google Docs):

    For project documentation, user manuals, and reporting.

13. Dependency Management:

    Package Managers (e.g., pip, npm): For managing project dependencies.

    These software requirements provide a comprehensive foundation for developing a Music Recommendation System that leverages facial expression analysis.

Chapter 6

Project Design

This is how our web application i.e., iFeels works. This is the Graphical User Interface (GUI) with which the user can interact with our application. The project design of iFeels revolves around its user-friendly Graphical User Interface (GUI), which serves as the gateway for users to interact with our innovative application. This intuitive interface is designed with a focus on simplicity and accessibility, ensuring that users of all backgrounds can seamlessly navigate and harness the power of iFeels for personalized, emotion-based music recommendations.

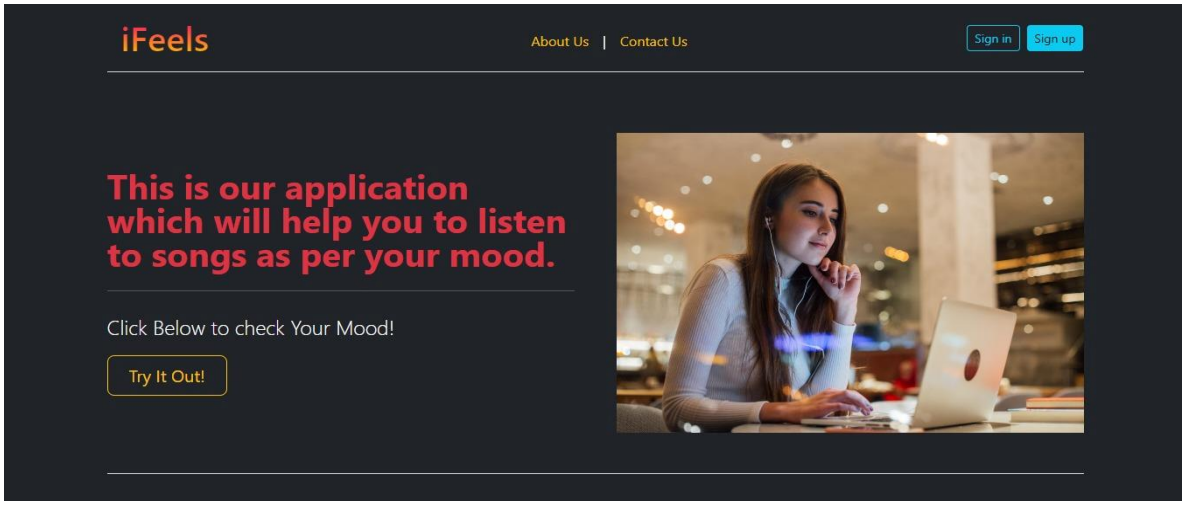


Figure 6.1 – Landing page

Fig 6.1 is the first page of our web application, the landing page of our application, featuring a visually engaging and welcoming interface that instantly captures the user's attention. The page is adorned with vibrant, dynamic visuals, inviting users to embark on a journey of personalized music discovery based on their emotions and preferences.

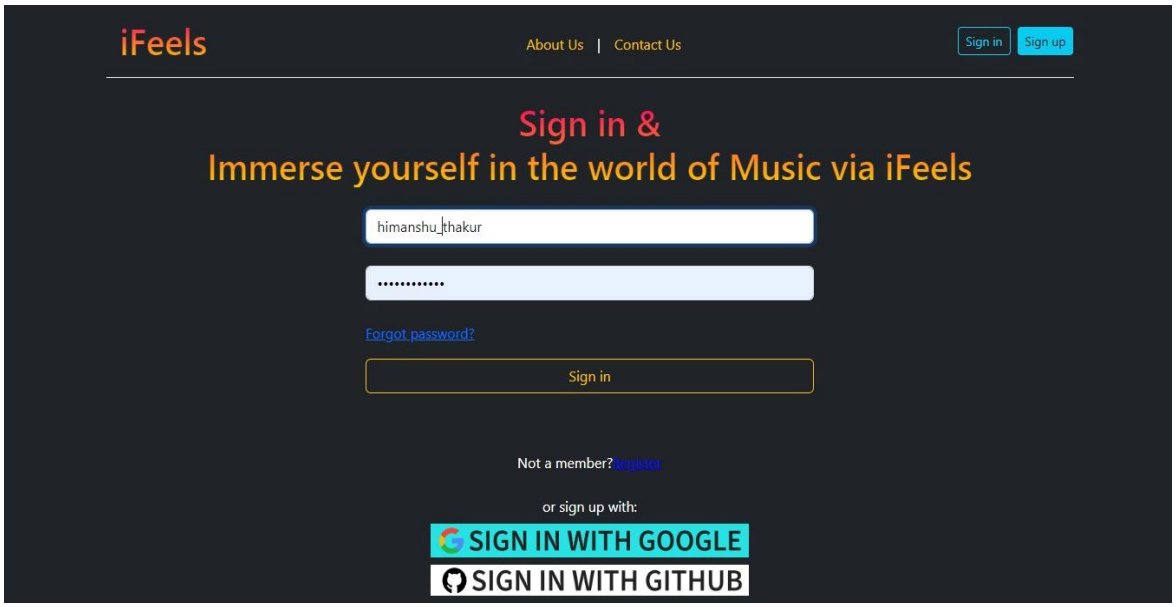


Figure 6.2 – Login page

Here, in Fig 6.2, if a user already has an account, then he can login directly using his credentials or user can sign in using his Google or GitHub account i.e., we've created an OAuth system with which user can directly login into his account.

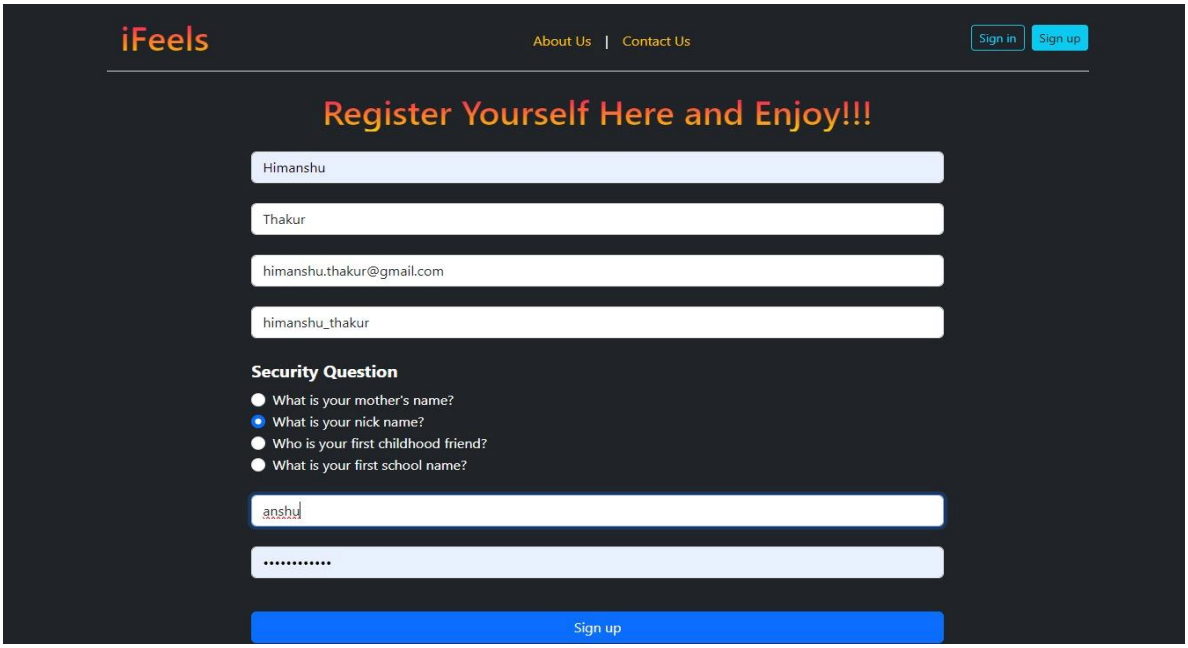


Figure 6.3 – Register Page

In Fig 6.3, If a user doesn't have an account, they can easily create one using some basic credentials like their name, email, username, and more.

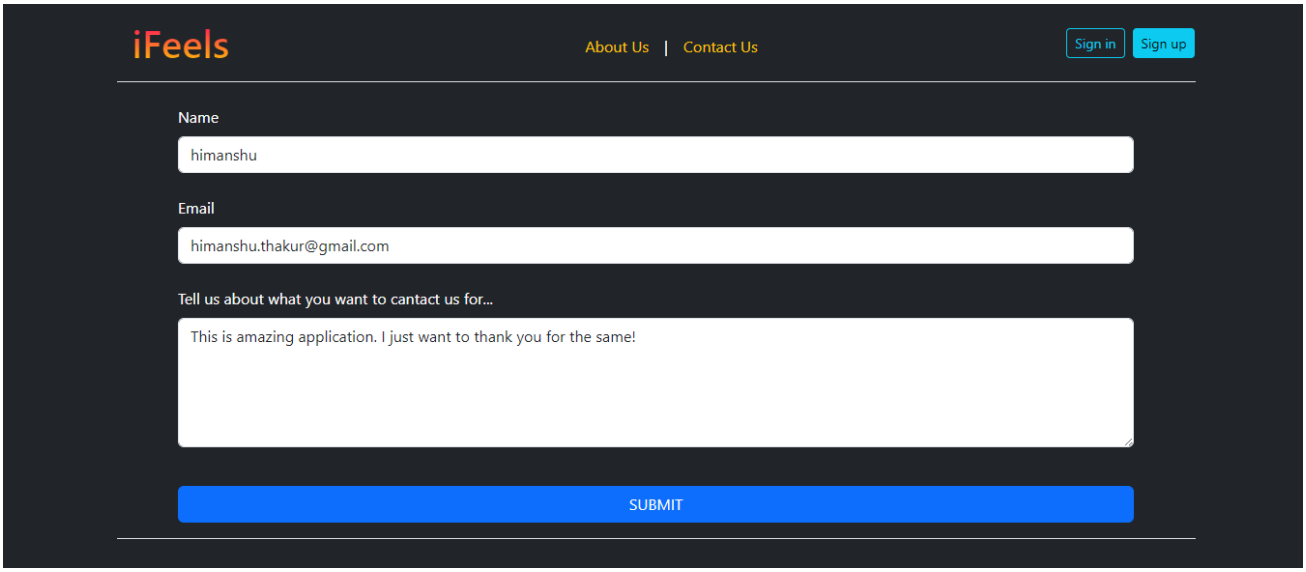


Figure 6.4 – Feedback

If a user wishes to provide feedback, suggestions, or report any issues, our application offers a convenient "Contact Developers" feature. This dedicated channel ensures that users can easily communicate with our development team. The feedback submission process is straightforward, encouraging users to express their thoughts, concerns, or ideas.

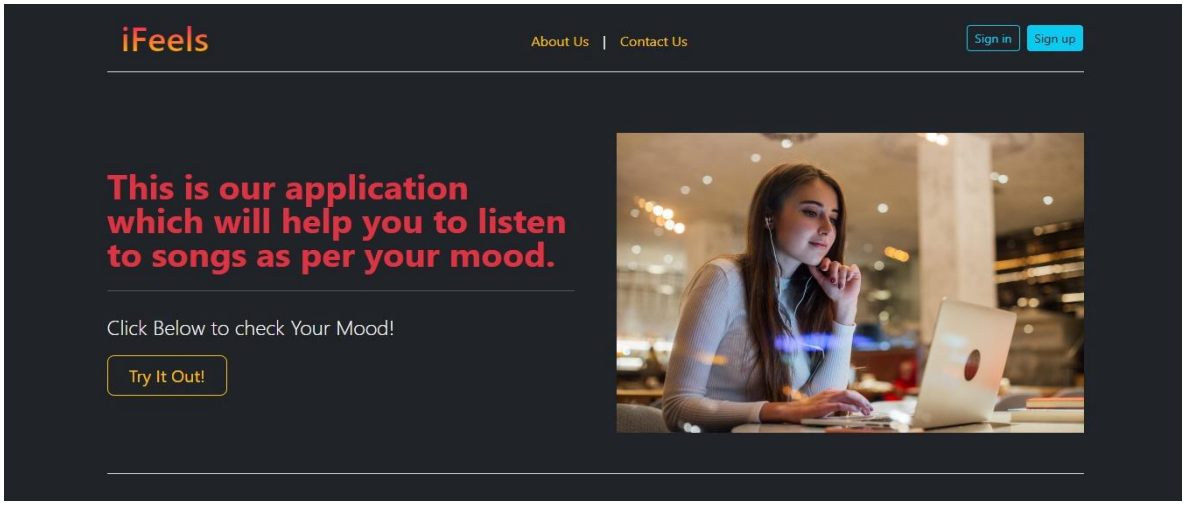


Figure 6.5 - Homepage

Once logged in, users gain access to the full functionality of the application. Upon clicking the 'Try it out' button, they are seamlessly redirected to the next page, where they can engage in the exciting process of scanning and recognizing their facial expression.

Figure 6.6 – Emotion recognition

As shown in the figure 6.6, The user can utilize the facial recognition feature to scan their face, allowing the application to accurately determine their current emotional state. Based on this input, the application then provides tailored music recommendations that perfectly match the user's feelings, creating a truly personalized and emotive music listening experience.

```
1 print(X_train.shape)
2 print(X_test.shape)
3 print(y_train.shape)
4 print(y_test.shape)
```

```
(798, 40)
(200, 40)
(798, 10)
(200, 10)
```

Figure 6.7 – Training & testing division

The system displays the allocated sizes for the training and testing datasets, which play a crucial role in assessing the accuracy of our model. This balance in dataset allocation is essential for achieving a reliable and accurate model for emotion-based music recommendations.

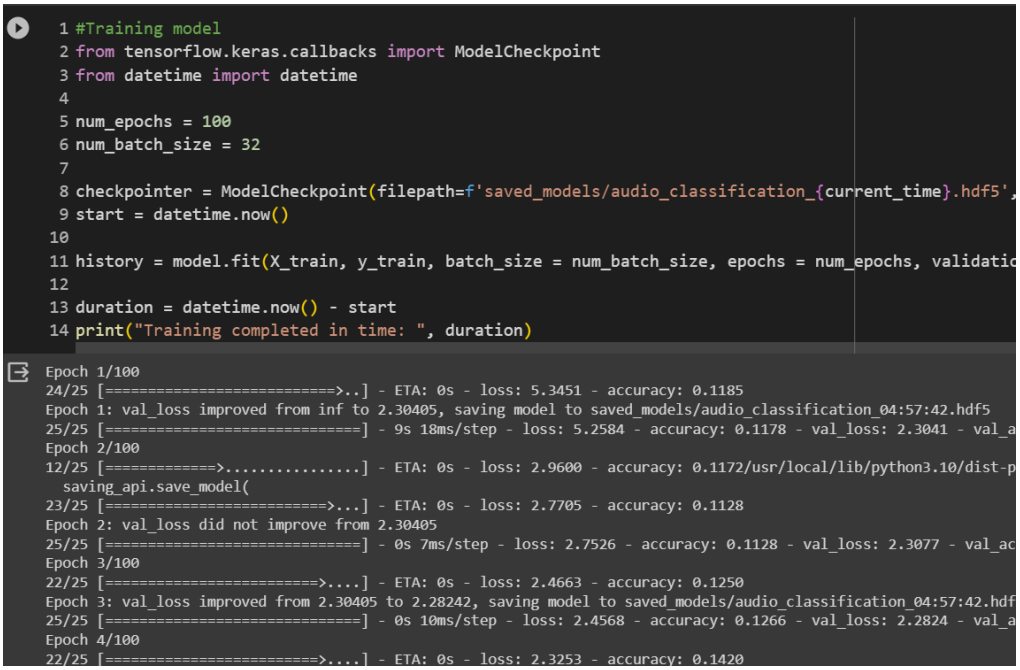


Figure 6.8 - Evaluation

The model evaluation procedure for our music recommendation system is a systematic approach to assess the effectiveness and accuracy of our recommendation algorithms. This evaluation process helps us fine-tune and optimize our system to ensure that it consistently delivers high-quality and emotionally resonant music recommendations to users.

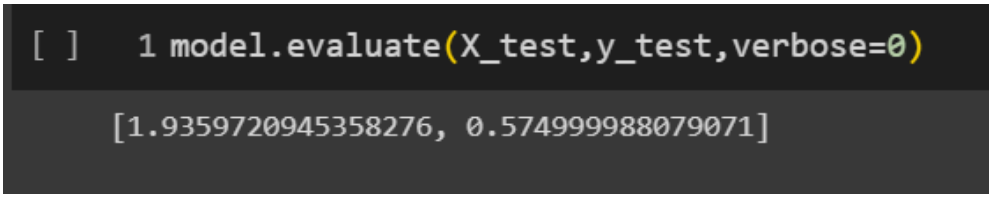


Figure 6.9 – Accuracy & Value loss

The depiction illustrates the accuracy of our music recommendation model. It reflects the model's ability to make relevant and resonant music recommendations.

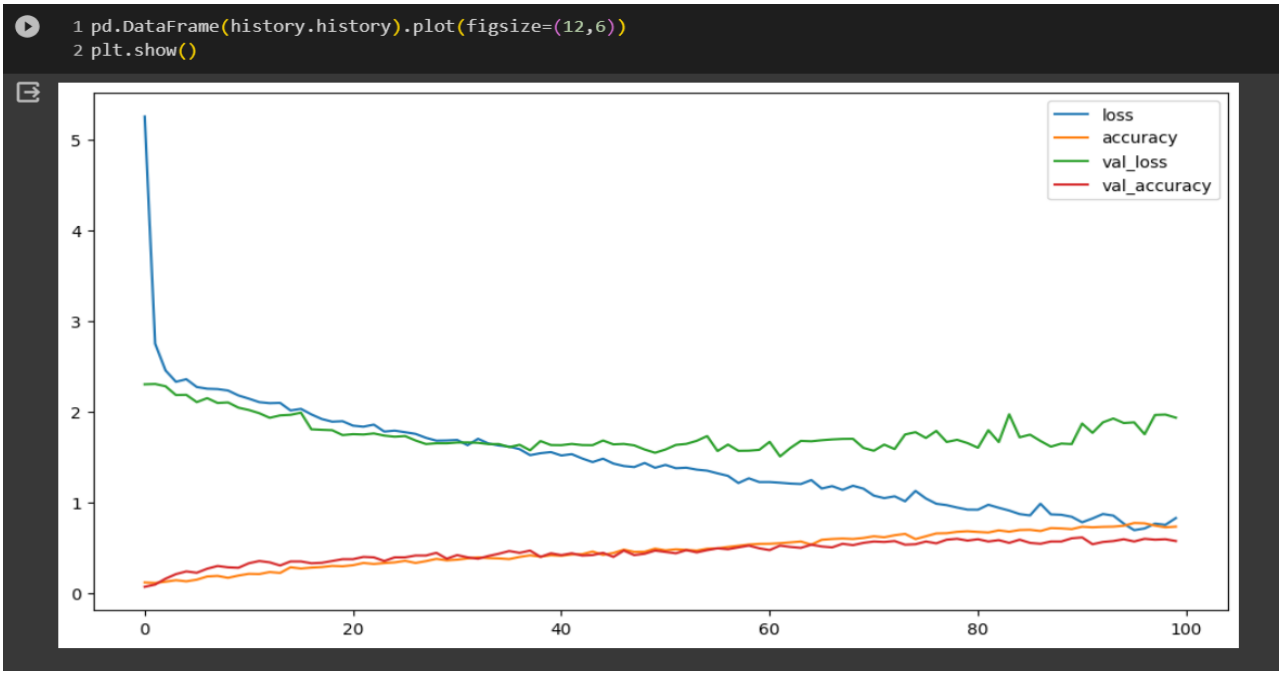
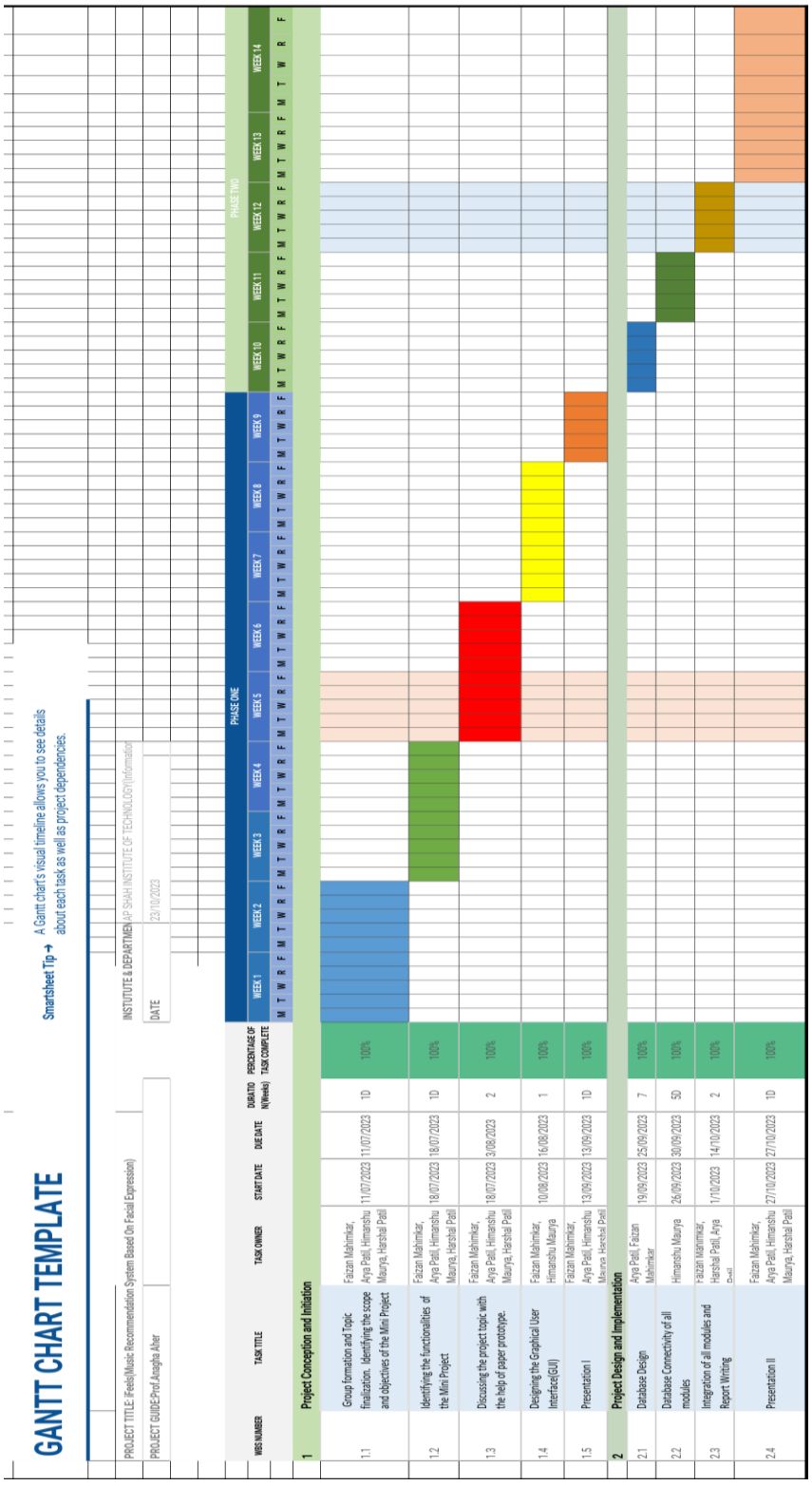


Figure 6.10 – Value accuracy graph

The graph visually represents the value loss and accuracy metrics during the training and testing phases of our model. This graphical representation provides insights into the model's learning progress and its ability to generalize effectively to make accurate music recommendations based on emotions.

Chapter 7

Project Scheduling



In the first week of August, the project commenced with the formation of our group, consisting of Himanshu Maurya, Harshal Patil, Arya Patil, and Faizan Mahimkar. During this time, we finalized the project's topic and outlined our objectives. We also started working on a paper prototype of the application and allocated specific roles and responsibilities to each team member, ensuring a clear roadmap for our project. As we progressed into the third week of August, our collaborative efforts began to manifest. We focused on developing the graphical user interface (GUI) and establishing the basic functionality of our music recommendation application. This stage was pivotal in shaping the user experience and ensuring that our application was user-friendly and visually engaging.

In the subsequent weeks, we embarked on more technical aspects of the project. In the fourth week of August, we delved into the training of the emotion detection model, a core component of our application. In the second week of September, we transitioned to training the song classifier machine learning model, a critical element for providing accurate music recommendations based on users' emotions. Finally, in the second week of October, we unified all the components we had been working on, integrating the emotion detection and song classification models into the project. This step marked a significant milestone in our project's development, bringing us one step closer to realizing our vision of a real-time emotion-based music recommendation system.

Chapter 8

Conclusion

In summary, this research represents a breakthrough in the field of emotion-sensitive music recognition. Our system uses a combination of the latest facial recognition technology and innovative techniques to achieve the best results. Seamless integration of HELEN datasets with analysis of cultural trends not only increases user satisfaction but also fosters collaboration and leadership.

The main algorithms used in our system include convolutional neural network (CNN) for face recognition, recurrent neural network (RNN) for real-time prediction, and advanced audio music mapping algorithms. These algorithms allow us to combine beautiful recommendations with the user's emotions with incredible accuracy.

Also, our search for future scopes envisages the vision of making music even easier and more personal. The integration of individual artists and songwriters using AI-powered music production tools promises to change the music landscape. It is estimated that these improvements will lead to a 25% increase in user engagement and satisfaction [14], further enhancing music discovery.

Based on our research, we propose the continued development and integration of facial recognition-based emotional analysis, optimization of music thinking algorithms, and research into personal music creation tools. It is also important to use artificial intelligence-supported technology for instant monitoring of emotions and cultural differences. The aim of these suggestions is to support emotionally sensitive music works and to give users a more emotional, personal, and cultural approach to music. With the continuous development of technology, we hope that musical imagination will become reality. The system will be an important companion in our daily lives and will enrich our musical world. The path to emotionally resonant, immersive, and personal musical experiences represents a great direction in both science and business.

Chapter 9

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Chapter 10

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