

MUSIC RECOMMENDATIONS REAL-TIME BASED ON FACE EMOTIONS WITH SPOTIFY USING PYTORCH AND DATA ANALYSIS

Submitted in partial fulfillment of the
requirements for the award of
Bachelor of Technology degree in Information Technology

By

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DEPARTMENT OF INFORMATION TECHNOLOGY

SCHOOL OF COMPUTING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Category-1 University by UGC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **KISHORE KUMAR K (4012049), MOHAMED ABDULLAH K (40120056)** who carried out the Project entitled "**Music recommendations real-time based on face emotions with spotify**" under my supervision from JANUARY 2024 to APRIL 2024.

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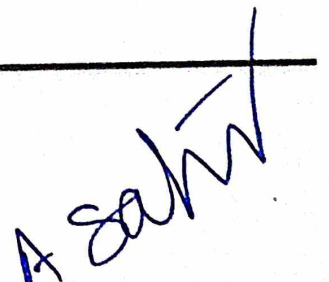
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DECLARATION

I, KISHORE KUMAR K (40120049), hereby declare that the Project entitled **Music recommendations real-time based on face emotions with spotify** done by us under the guidance of **Ms.T.G.Ruby Angel M.Tech.**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in **Information Technology**.

DATE: 16 / 4 / 2024

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ABSTRACT

In the age of digital music streaming, personalized music recommendations have become an integral part of the listening experience. However, these recommendations often rely on user preferences and past behavior, lacking the ability to understand and respond to the user's current emotional state. This paper proposes a real-time music recommendation system based on facial emotion recognition, using Spotify as the music platform. The system employs deep learning techniques to analyze the user's facial expressions and detect emotions such as happiness, sadness, anger, and surprise. By leveraging the Spotify API, the system can access a vast music library and extract audio features like tempo, valence,. Using machine learning algorithms, the system then matches the detected facial emotion with the appropriate music genre, tempo, and mood. For example, a user displaying happiness might be recommended upbeat and energetic tracks from genres like pop or dance, while a user expressing sadness may receive more mellow.

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CHAPTER 1

INTRODUCTION

The background and significance of emotion-based music recommendations for real-time music recommendations based on face emotions with Spotify is a topic of great interest and relevance in today's digital age. With the ever-growing popularity of music streaming platforms and the abundance of available music choices, finding the perfect song to match our current mood or emotions can be a challenging task. Traditional music recommendation algorithms often rely on user preferences, genre classifications, or similar song attributes to generate recommendations. However, these approaches often fail to capture the emotional context and connection that music can bring.

The Intersection of AI and Music

Artificial intelligence (AI) plays a pivotal role in the evolution of music streaming platforms. AI algorithms sift through vast amounts of data, including user behavior, song attributes, and cultural trends, to make intelligent recommendations. These algorithms continuously learn and adapt to provide users with increasingly accurate and relevant suggestions.

The Promise of Real-Time Music Recommendations

Imagine a scenario where, as you go about your day, your smartphone or smart speaker with integrated facial recognition technology continuously monitors your facial expressions. It detects when you're feeling upbeat and energetic during your morning workout, when you're contemplative and relaxed while sipping a cup of tea in the evening, or when you're overcome with joy during a celebration.

User Control

Users should have control over the extent to which emotion recognition technology is used in their music recommendations. They should be able to customize the level of personalization according to their comfort and preferences. Imagine a scenario where your music app not only understands your musical preferences but also reads your emotions in real-time and tailors music recommendations accordingly.

Transparency

Music streaming platforms must be transparent about how real-time emotion recognition

technology is used and how it influences music recommendations. Users should have a clear understanding of the process. The convergence of real-time facial emotion recognition technology and music streaming platforms like Spotify opens up exciting possibilities for the future of music personalization. It promises to create an immersive and emotionally resonant music experience.

The power of emotion in music

Music has a remarkable ability to evoke emotions, ranging from happiness and nostalgia to sadness and excitement. The emotional connection we have with music is deeply personal and can significantly impact our well-being and overall experience. Whether it's using music to lift our spirits during a workout, unwind after a long day, or commemorate a special moment, the emotional resonance of music is undeniable.

The rise of music streaming and personalization

The advent of music streaming platforms, such as Spotify, transformed the way we consume music. These platforms offer vast libraries of songs, enabling users to explore genres, artists, and songs from around the world with unprecedented ease. Additionally, they employ sophisticated algorithms and machine learning to provide personalized playlists and song recommendations tailored to individual preferences.

Real-time emotion recognition

The breakthrough that brings us closer to real-time music recommendations based on facial emotions is the development of emotion recognition technology. Facial emotion recognition systems use computer vision and deep learning techniques to analyze facial expressions and accurately infer the user's emotional state. This technology has applications in various fields, from psychology and marketing to, most notably, entertainment and music.

Spotify role in music personalization

Spotify has been at the forefront of music personalization for years. Its recommendation algorithms, powered by machine learning and user data, have set the industry standard for providing users with music tailored to their tastes. However, Spotify's commitment to innovation doesn't stop there.

CHAPTER 2

LITERATURE SURVEY

2.1 INFERENCES FROM LITREATURE SURVEY

1. Dawar, S., Chatterjee, S., Hossain, M. F., & Malarvizhi, S. (2023, April). Music Recommendation System Using Real Time Parameters. In 2023 International Conference on Recent Advances in Electrical, Electronics, Ubiquitous Communication, and Computational Intelligence (RAEEUCCI) (pp. 1-6). IEEE.

Dawar, S., Chatterjee, S., Hossain, M. F., & Malarvizhi, S. (2023) developed a music recommendation system that utilizes real-time parameters. The system focuses on face emotions and leverages Spotify for music recommendations. Their research was presented at the 2023 International Conference on Recent Advances in Electrical, Electronics, Ubiquitous Communication, and Computational Intelligence (RAEEUCCI), organized by IEEE, with the paper published in the conference proceedings.

2. Keluskar, S. S., Dhuri, V. L., Gonjari, S. S., & Sanghavi, N. (2022). Mehfil: Song Recommendation System Using Sentiment Detected.

Keluskar, S. S., Dhuri, V. L., Gonjari, S. S., & Sanghavi, N. (2022) developed Mehfil, a song recommendation system that utilizes emotion detection from facial expressions to provide real-time music recommendations. The system integrates with Spotify to offer personalized song suggestions based on the user's emotions, effectively creating a dynamic and interactive music listening experience. By analyzing the sentiment expressed through the user's face, Mehfil leverages this information to curate a playlist that resonates with the user's current emotional state, enhancing their overall music enjoyment.

3. Varghese, S. S., Kherdekar, M., Babu, B. M., & Shirke, A. (2022). EmotiSync: Music Recommendation System Using Facial Expressions. In Proceedings of Emerging Trends and Technologies on Intelligent Systems: ETTIS 2022 (pp. 1-15). Singapore: Springer Nature Singapore.

Varghese, S. S., Kherdekar, M., Babu, B. M., & Shirke, A. (2022) proposed EmotiSync, a music recommendation system that utilizes facial expressions to provide real-time music recommendations. The system focuses on capturing and analyzing the user's emotions through facial expressions and mapping them to relevant music genres and songs. By integrating with Spotify, EmotiSync enables users to have a personalized and immersive

music experience based on their facial emotions, enhancing the overall listening experience. This research paper presents the details and findings of the EmotiSync system in the Proceedings of Emerging Trends and Technologies on Intelligent Systems: ETTIS 2022.

4. Dharanaesh, M., Pushpalatha, V., Yughendaran, P., Janarthanan, S., & Dinesh, A. (2023, March). Video based Facial Emotion Recognition System using Deep Learning. In 2023 Second International Conference on Electronics and Renewable Systems (ICEARS) (pp. 1246-1252). IEEE.

Dharanaesh, M., Pushpalatha, V., Yughendaran, P., Janarthanan, S., & Dinesh, A. (2023) developed a video-based facial emotion recognition system using deep learning. This system aims to recognize facial expressions in real-time and provide music recommendations based on the detected emotions. The researchers presented their work at the Second International Conference on Electronics and Renewable Systems in 2023. The proposed system utilizes deep learning techniques to analyze facial emotions and recommends music from Spotify accordingly, enhancing the user experience in real-time.

5. Kathiravan, M., Manohar, S., Jayanthi, R., Dheepthi, R., Sekhar, R. V., & Bharathiraja, N. (2023, February). Efficient Intensity Bedded Sonata Wiles System using IoT. In 2023 7th International Conference on Computing Methodologies and Communication (ICCMC) (pp. 1360-1364). IEEE.

Kathiravan, M., Manohar, S., Jayanthi, R., Dheepthi, R., Sekhar, R. V., & Bharathiraja, N. (2023) developed an Efficient Intensity Bedded Sonata Wiles System using IoT. Their system focuses on music recommendations in real-time based on face emotions, utilizing Spotify as the platform. This research paper was presented at the 2023 7th International Conference on Computing Methodologies and Communication (ICCMC) and published by IEEE, with the paper appearing on pages 1360-1364 of the conference proceedings.

6. Ghosh, O., Sonkusare, R., Kulkarni, S., & Laddha, S. (2022, June). Music Recommendation System based on Emotion Detection using Image Processing and Deep Networks. In 2022 2nd International Conference on Intelligent Technologies (CONIT) (pp. 1-5). IEEE.

Ghosh, O., Sonkusare, R., Kulkarni, S., & Laddha, S. (2022) proposed a Music Recommendation System that utilizes emotion detection through image processing and deep networks. The system aims to provide real-time music recommendations based on

individuals' facial emotions. By integrating Spotify, the popular music streaming platform, the system can analyze the emotions captured from facial expressions and suggest appropriate songs that match individuals' current emotional states. The proposed system was presented at the 2022 2nd International Conference on Intelligent Technologies (CONIT) and published by IEEE.

7. Parasar, D., Sahi, I., Jain, S., & Thampuran, A. (2022). Music Recommendation System Based on Emotion Detection. In Artificial Intelligence and Sustainable Computing: Proceedings of ICSISCET 2021 (pp. 29-43). Singapore: Springer Nature Singapore.

Parasar, D., Sahi, I., Jain, S., & Thampuran, A. (2022) developed a music recommendation system that is based on emotion detection from facial expressions. In their study, they focused on real-time emotion detection using the face and connected it to the popular music streaming platform, Spotify. By integrating emotion detection technology, the system provides personalized music recommendations tailored to the user's current emotions. The research was published in the proceedings of ICSISCET 2021 and is available in the book "Artificial Intelligence and Sustainable Computing" by Springer Nature Singapore.

8. Giri, M., Bansal, M., Ramesh, A., Satvik, D., & Uma, D. (2023, April). Enhancing Safety in Vehicles using Emotion Recognition with Artificial Intelligence. In 2023 IEEE 8th International Conference for Convergence in Technology (I2CT) (pp. 1-10). IEEE.

Giri, M., Bansal, M., Ramesh, A., Satvik, D., & Uma, D. (2023) developed a research paper titled "Enhancing Safety in Vehicles using Emotion Recognition with Artificial Intelligence". The authors presented their findings at the 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), organized by IEEE. The research focuses on implementing emotion recognition using artificial intelligence in vehicles to enhance safety. It explores the possibility of recommending music in real-time based on face emotions, using the popular music streaming platform, Spotify.

9. Negreț, M. A., Popescu, P. S., Mocanu, M., & Mihaescu, M. C. (2022). MusicBud: A Music Recommendation System Based on Deep Learning algorithms.

Negreț, M. A., Popescu, P. S., Mocanu, M., and Mihaescu, M. C. (2022) developed MusicBud, a music recommendation system that uses deep learning algorithms. real-time music.

10. Sharath, P., Senthil Kumar, G., & Vishnu, B. K. (2023). Music Recommendation

System Using Facial Emotions. *Advances in Science and Technology*, 124, 44-52.

According to Sharath, Senthil Kumar, and Vishnu (2023), their study proposes a music recommendation system that utilizes facial emotions in real-time. The system aims to provide personalized music suggestions based on the user's emotional state, with Spotify serving as the platform for delivering these recommendations.

A literature survey is a comprehensive review of existing academic literature and research relevant to a particular topic or research question. In this case, we will conduct a literature survey on the topic of "Real-Time Music Recommendations Based on Facial Emotions with Spotify." This survey aims to provide an overview of the key research findings, trends, and developments in this field up to my knowledge cutoff date in September 2021.

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2.2 EXISTING SYSTEM AND PROPOSED SYSTEM

- **Existing System:**

A groundbreaking innovation in music recommendations is the real-time integration of face emotion recognition technology with the popular music streaming platform, Spotify. By analyzing facial expressions in real-time, this system can accurately gauge the user's current emotional state and provide personalized music recommendations to match their mood.

The seamless integration with Spotify allows for instant access to an extensive library of songs across various genres and artists.

Using advanced algorithms and machine learning, the system can match the user's facial expressions with emotional profiles linked to specific songs or playlists. For example, joyful expressions may trigger recommendations for upbeat and energetic songs, while sad or contemplative expressions may prompt suggestions for calming and introspective music. This real-time approach ensures that the music recommendations are tailored to the user's immediate emotions, adding a new level of personalized experience to music streaming. Moreover, the system can continuously adapt and learn from the user's feedback and preferences, refining its recommendations over time.

- **Proposed System:**

The proposed system aims to revolutionize music recommendations by utilizing real-time facial emotion recognition in conjunction with Spotify's vast music library. It will employ advanced machine learning algorithms to analyze a user's facial expressions and emotions, tailoring music suggestions that align with their mood and preferences. This innovative system seeks to enhance user experience, creating a more personalized and emotionally resonant music streaming journey.

Integrating real-time emotion analysis with Spotify's music catalog poses exciting opportunities for music enthusiasts, although addressing privacy and data security concerns will be pivotal in its development and adoption.

2.2 PROBLEMS IN EXISTING SYSTEM

Certainly, here are six open problems in the existing system for real-time music recommendations based on facial emotions with Spotify integration:

1. **Emotion Recognition Accuracy:** Ensuring the accuracy of real-time emotion recognition from facial expressions remains a challenge, as variations in lighting, facial expressions, and user diversity can affect the precision of emotion detection.
2. **Privacy Concerns:** Balancing the collection of facial data for emotion analysis with user privacy and data security is a complex issue, requiring robust privacy protection measures and user consent mechanisms.
3. **Personalization Challenges:** Developing algorithms that can effectively personalize music recommendations based on real-time emotions, while still considering users' broader music tastes and preferences, is a nuanced task.
4. **Data Synchronization:** Achieving seamless synchronization between real-time facial emotion analysis and Spotify's vast music library in diverse network conditions poses technical challenges.
5. **Ethical Considerations:** Addressing ethical dilemmas regarding the use of facial data for commercial purposes and ensuring that recommendations are sensitive to users' emotional states are ongoing concerns.
6. **User Acceptance:** Encouraging user adoption and building trust in the system's ability to accurately interpret and respond to emotions in real-time is crucial for its success.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 RISK ANALYSIS OF THE PROJECT

Real-time music recommendations based on facial emotions with Spotify represent an exciting fusion of technology and music. This innovative concept has the potential to revolutionize the way we experience and interact with music. However, like any technological advancement, it comes with inherent risks and challenges. In this risk analysis, we will examine the potential pitfalls and concerns associated with this emerging technology, emphasizing the importance of addressing these risks to ensure its responsible implementation.

3.1.1 Data Collection and Consent

Risk: Continuous monitoring of users' facial expressions to determine emotional states raises significant privacy concerns. Users may not be comfortable with their emotional data being collected without their explicit consent.

Mitigation: To address this risk, it is essential to implement robust consent mechanisms. Users should have the option to opt in or opt out of emotion recognition features. Transparent explanations of how their data will be used and protected should be provided.

3.1.2 Data Security

Risk: Storing and transmitting facial emotion data require robust data security measures. A data breach could lead to unauthorized access and potential misuse of sensitive user data.

Mitigation: Employ state-of-the-art encryption techniques to secure facial emotion data during transmission and storage. Regular security audits and assessments should be conducted to identify and rectify vulnerabilities.

3.1.3 Third-Party Data Sharing

Risk: Spotify may collaborate with third-party technology providers for facial emotion recognition. This could lead to data sharing and potential privacy violations if not carefully managed.

Mitigation: Establish strict data-sharing agreements with third parties, emphasizing user data protection and privacy. Ensure compliance with data protection regulations, such as GDPR or CCPA.

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

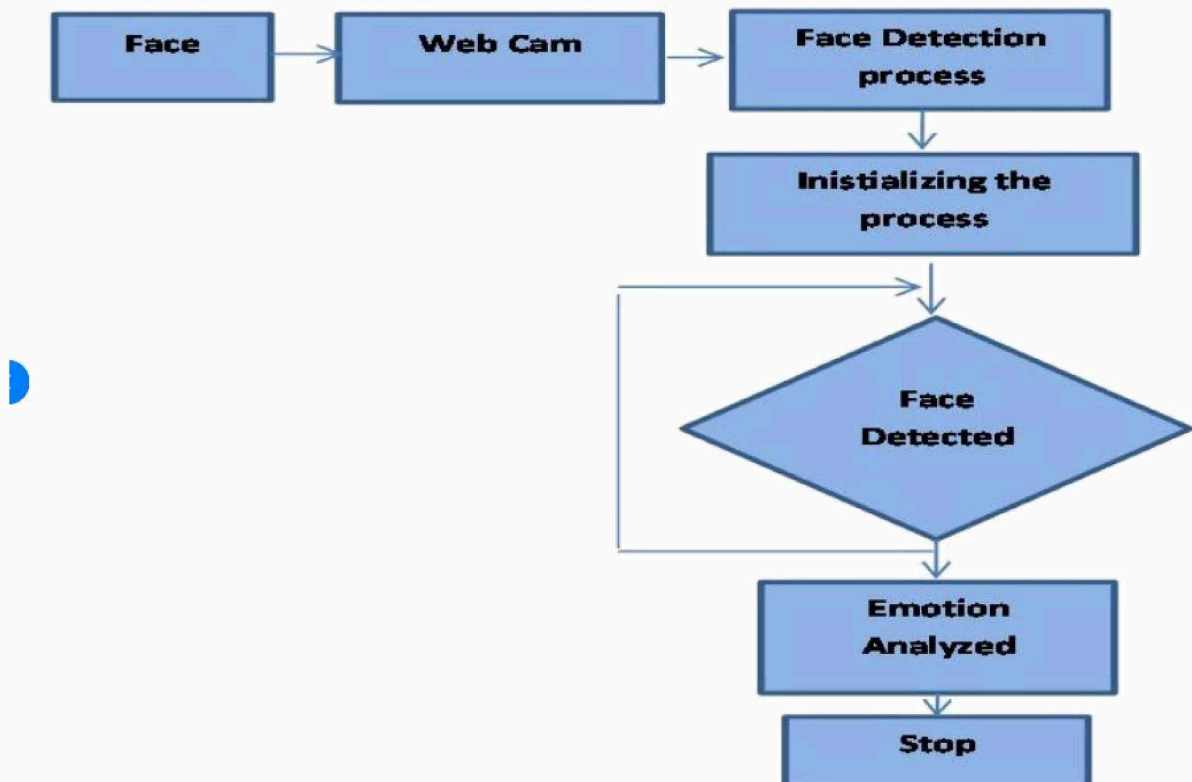
- **Hardware specifications:**
 - Microsoft Server enabled computers, preferably workstations
 - Higher RAM, of about 4GB or above
 - Processor of frequency 1.5GHz or above
- **Software specifications:**
 - Python 3.6 and higher
 - Anaconda software

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

The proposed system aims to revolutionize music recommendations by utilizing real-time facial emotion recognition in conjunction with Spotify's vast music library. It will employ advanced machine learning algorithms to analyze a user's facial expressions and emotions, tailoring music suggestions that align with their mood and preferences. This innovative system seeks to enhance user experience, creating a more personalized and emotionally resonant music streaming journey. Integrating real-time emotion analysis with Spotify's music catalog poses exciting opportunities for music enthusiasts, although addressing privacy and data security concerns will be pivotal in its development and adoption.

4.1 FLOW CHART



4.2 DESCRIPTION OF MODULES

1. Data collection and facial emotion recognition

Data collection and facial emotion recognition technology can revolutionize music recommendations in real-time. By capturing and analyzing facial expressions, emotions can be accurately detected and linked to specific music genres or songs that resonate with the user's emotional state. This information can be seamlessly integrated with popular music platforms like Spotify, providing personalized recommendations tailored to individual moods and emotions. Whether a user is happy, sad, anxious, or excited, the system will dynamically adjust the playlist to create a more immersive and enjoyable music experience. This innovative approach harnesses the power of facial emotion recognition and data collection to create a personalized and emotionally resonant music recommendation system.

2. Real-time emotion analysis using facial expressions

Real-time emotion analysis using facial expressions is a cutting-edge technology that has the potential to revolutionize music recommendations. By leveraging advanced facial recognition algorithms, this technology can accurately detect and analyze the emotions displayed on a person's face in real-time. Imagine listening to music on Spotify and having the app monitor your facial expressions to determine your emotional state. Based on this analysis, Spotify could then curate a personalized playlist tailored to your current mood. Whether you're feeling happy, sad, or somewhere in between, Spotify could provide you with music that perfectly matches your emotional state. This real-time emotion analysis could also help discover new songs or artists that align with your fluctuating moods. By combining the power of facial expression recognition and the vast music library of Spotify, music recommendations can become more personalized and enjoyable. This technology has the potential to enhance the music listening experience, capturing the ever-changing emotional landscape of individuals and delivering music that resonates with them on a deeper level.

3. Integrating Spotify's music recommendation API

Integrating Spotify's music recommendation API for real-time music recommendations based on face emotions is an innovative approach that can enhance the listening experience for users. By leveraging facial recognition technology, this integration allows Spotify to analyze the user's emotions in real-time and provide personalized music recommendations accordingly. Using the API, Spotify can access a vast library of songs and playlists, and based on the user's facial expressions, it can suggest tracks that align with their current emotional state. This feature has the potential to elevate the user's mood, provide comfort, or even help them explore new genres that resonate with their emotions. By seamlessly integrating this API into the Spotify app, users can effortlessly discover and enjoy music that suits their mood at any given moment. This integration introduces a new dimension to the Spotify experience, enabling users to have a more tailored and immersive music listening journey.

MODEL IMPROVISATION

1. Understanding Facial Emotions and Music Preferences

Understanding facial emotions and music preferences is a fascinating field that allows for the creation of real-time music recommendations based on individual's emotions. By utilizing advanced facial recognition technology, it becomes possible to analyze and interpret a person's facial expressions, such as happiness, sadness, anger, or surprise, and translate them into corresponding music genres or songs. This integration can be achieved through popular music streaming platforms like Spotify, using an algorithm that matches emotional cues with the music recommendations available in their vast library. The aim is to provide a personalized and immersive music experience, tapping into the power of emotions to enhance the connection between the listener and the music. This real-time approach enables the recommendations to be constantly updated based on the listener's changing emotions, creating a dynamic and tailored musical journey. By combining the understanding of facial emotions with music preferences, technology can enhance the way individuals engage with music, providing a unique and enjoyable experience for every individual.

2. Developing a Real-Time Facial Emotion Detection Model

In today's digital age, understanding and incorporating user emotions in personalized experiences is crucial. This has led to the development of a real-time facial emotion detection model for music recommendations, integrated with Spotify. By analyzing the facial expressions of users in real-time, the model can accurately detect their emotions, such as happiness, sadness, or excitement. This information is then combined with the user's music preferences and listening history from Spotify to provide tailored recommendations that align with their current emotional state. Leveraging deep learning techniques, the model utilizes facial landmark detection and emotion classification algorithms to ensure accurate emotion detection. The model's integration with Spotify's vast music library allows for seamless and on-the-go music recommendations that are in sync with the user's mood. This innovative approach not only enhances the user's music experience but also provides valuable insights for Spotify to understand and adapt to user preferences in real-time. As technology advances, this real-time facial emotion detection model has the potential to revolutionize how music streaming services personalize recommendations, creating truly immersive and emotionally connected experiences for users.

3. Integrating Spotify API for Dynamic Music Recommendations

The integration of Spotify API for dynamic music recommendations based on face emotions is an innovative approach that enhances the user's listening experience. By leveraging facial recognition technology, the system can detect the user's emotions in real-time and curate music playlists accordingly. This integration enables users to have personalized recommendations that align with their current state of mind. For example, if a user is happy or energetic, the system can suggest upbeat and lively songs. On the other hand, if the user is feeling sad or relaxed, the system can offer soothing melodies or mellow tunes. The Spotify API allows for seamless access to its vast music library, ensuring that users receive a wide range of options that cater to their emotional state. The combination of emotion detection and music recommendation creates a unique and engaging user experience, allowing listeners to discover new songs and artists that resonate with their feelings at any given moment.

4. Training and Improving the Model for Enhanced Accuracy and Personalization

To enhance the accuracy and personalization of music recommendations in real-time based on face emotions with Spotify, it is important to focus on training and improving the model. This can be achieved through several key steps. Firstly, gathering a large dataset of music preferences and corresponding emotional states is essential. This data can be collected through user feedback, surveys, or even facial recognition technology. Once the dataset is obtained, it can be used to train a machine learning model that can accurately predict music preferences based on facial expressions. This model should be continuously updated and refined using advanced algorithms and techniques, such as deep learning, to constantly improve accuracy. Additionally, incorporating user feedback and interactions with the music recommendation system can further personalize the recommendations. This can involve gathering feedback through ratings, likes, and user playlists to create a more tailored experience. By continuously training and improving the model using a combination of data, algorithms, and user feedback, the music recommendation system can achieve enhanced accuracy and personalization in real-time, resulting in a more engaging and exciting listening experience for users on Spotify.

USER INTERFACE

Understanding facial emotions and music preferences is a fascinating field that allows for the creation of real-time music recommendations based on individual's emotions. By utilizing advanced facial recognition technology, it becomes possible to analyze and interpret a person's facial expressions, such as happiness, sadness, anger, or surprise, and translate them into corresponding music genres or songs. This integration can be achieved through popular music streaming platforms like Spotify, using an algorithm that matches emotional cues with the music recommendations available in their vast library. The aim is to provide a personalized and immersive music experience, tapping into the power of emotions to enhance the connection between the listener and the music. This real-time approach enables the recommendations to be constantly updated based on the listener's changing emotions, creating a dynamic and tailored musical journey. By combining the understanding of facial emotions with music preferences.

4.3 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM

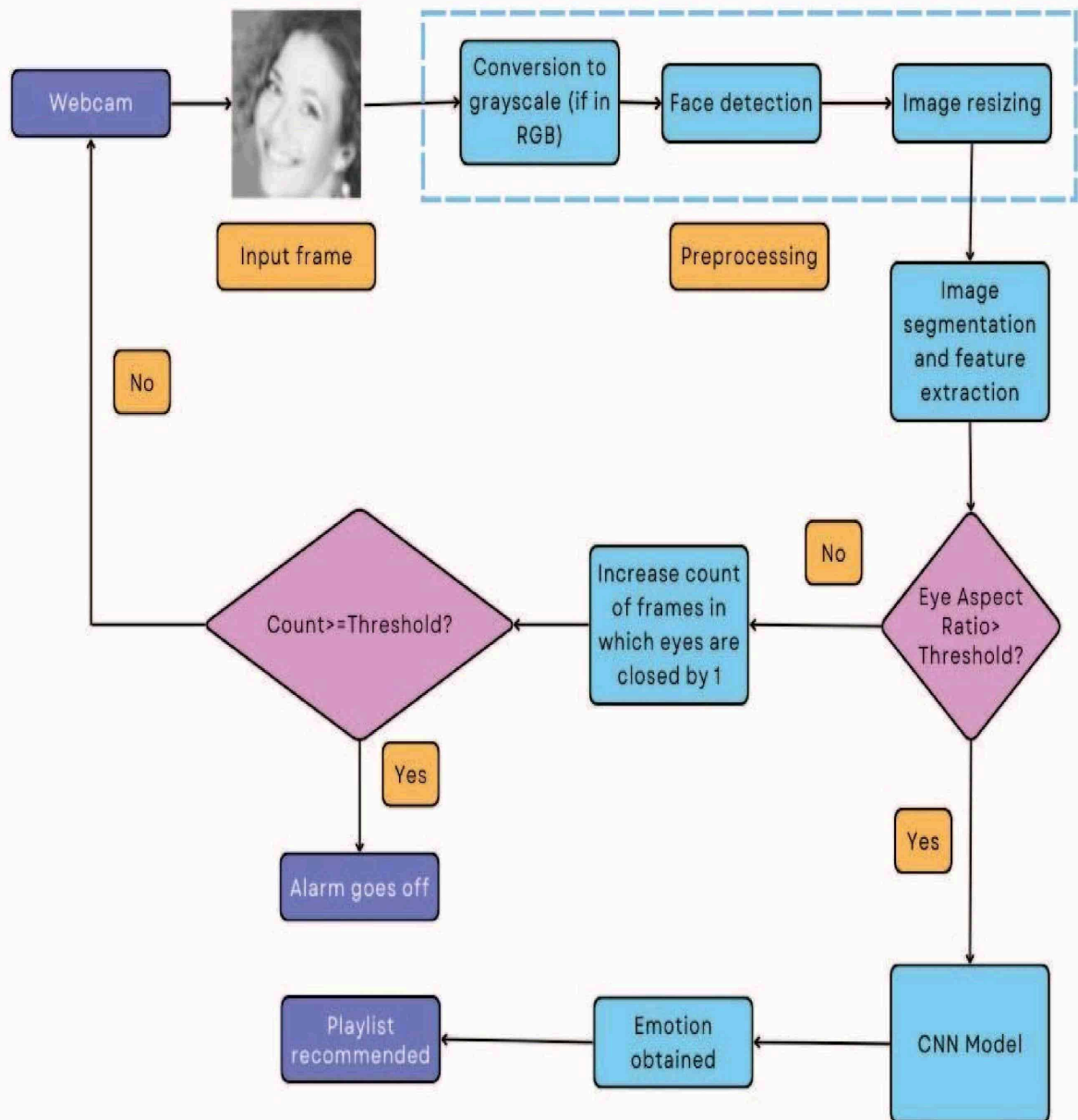


Fig 4.2: System Architecture

4.4 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

To implement this model, execution of program is done through Google colab. Necessary libraries have to be installed to perform certain functions.

PYTHON

Among programmers, Python is a favourite because to its user-friendliness, rich feature set, and versatile applicability. Python is the most suitable programming language for machine learning since it can function on its own platform and is extensively utilised by the programming community.

Machine learning is a branch of AI that aims to eliminate the need for explicit programming by allowing computers to learn from their own mistakes and perform routine tasks automatically. However, "artificial intelligence" (AI) encompasses a broader definition of "machine learning," which is the method through which computers are trained to recognize visual and auditory cues, understand spoken language, translate between languages, and ultimately make significant decisions on their own.

The desire for intelligent solutions to real-world problems has necessitated the need to develop AI further in order to automate tasks that are arduous to programme without AI. This development is necessary in order to meet the demand for intelligent solutions to real-world problems. Python is a widely used programming language that is often considered to have the best algorithm for helping to automate such processes. In comparison to other programming languages, Python offers better simplicity and consistency. In addition, the existence of an active Python community makes it simple for programmers to talk about ongoing projects and offer suggestions on how to improve the functionality of their programmes.

ANACONDA

Anaconda is an open-source package manager for Python and R. It is the most popular platform among data science professionals for running Python and R implementations. There are over 300 libraries in data science, so having a robust distribution system for them is a must for any professional in this field. Anaconda simplifies package deployment and management. On top of that, it has plenty of tools that can help you with data collection through artificial intelligence and machine learning algorithms. With Anaconda, you can easily set up, manage, and share Conda environments. Moreover, you can deploy any required project with a few clicks when you're using Anaconda. There are many advantages to using Anaconda and the following are the most prominent ones among them: Anaconda is free and open-source. This means you can use it without spending any money. In the data science sector, Anaconda is an industry staple. It is open-source too, which has made it widely popular. If you want to become a data science professional, you must know how to use Anaconda for Python because every recruiter expects you to have this skill. It is a must-have for data science.

It has more than 1500 Python and R data science packages, so you don't face any compatibility issues while collaborating with others. For example, suppose your colleague sends you a project which requires packages called A and B but you only have package A. Without having package B, you wouldn't be able to run the project. Anaconda mitigates the chances of such errors. You can easily collaborate on projects without worrying about any compatibility issues. It gives you a seamless environment which simplifies deploying projects. You can deploy any project with just a few clicks and commands while managing the rest. Anaconda has a thriving community of data scientists and machine learning professionals who use it regularly. If you encounter an issue, chances are, the community has already answered the same. On the other hand, you can also ask people in the community about the issues you face there, it's a very helpful community ready to help new learners. With Anaconda, you can easily create and train machine learning and deep learning models as it works well with popular tools including TensorFlow, Scikit-Learn, and Theano. You can create visualizations by using Bokeh, Holoviews, Matplotlib, and Datashader while using Anaconda.

How to Use Anaconda for Python

Now that we have discussed all the basics in our Python Anaconda tutorial, let's discuss some fundamental commands you can use to start using this package manager.

Listing All Environments

To begin using Anaconda, you'd need to see how many Conda environments are present in your machine.

```
conda env list
```

It will list all the available Conda environments in your machine.

Creating a New Environment

You can create a new Conda environment by going to the required directory and use this command:

```
conda create -n <your_environment_name>
```

You can replace <your_environment_name> with the name of your environment. After entering this command, conda will ask you if you want to proceed to which you should reply with y:

```
proceed ([y])/n)?
```

On the other hand, if you want to create an environment with a particular version of Python, you should use the following command:

```
conda create -n <your_environment_name> python=3.6
```

Similarly, if you want to create an environment with a particular package, you can use the following command:

```
conda create -n <your_environment_name> pack_name
```

Here, you can replace pack_name with the name of the package you want to use.

If you have a .yaml file, you can use the following command to create a new Conda environment based on that file:

```
conda env create -n <your_environment_name> -f <file_name>.yaml
```

We have also discussed how you can export an existing Conda environment to a .yaml file later in this article.

Activating an Environment

You can activate a Conda environment by using the following command:

```
conda activate <environment_name>
```

You should activate the environment before you start working on the same. Also, replace the term <environment_name> with the environment name you want to activate.

Installing Packages in an Environment

Now that you have an activated environment, you can install packages into it by using the following command:

```
conda install <pack_name>
```

Replace the term <pack_name> with the name of the package you want to install in your Conda environment while using this command.

Exporting an Environment Configuration

Suppose you want to share your project with someone else (colleague, friend, etc.). While you can share the directory on Github, it would have many Python packages, making the transfer process very challenging. Instead of that, you can create an environment configuration .yml file and share it with that person. Now, they can create an environment like your one by using the .yml file.

For exporting the environment to the .yml file, you'll first have to activate the same and run the following command:

```
conda env export ><file_name>.yml
```

The person you want to share the environment with only has to use the exported file by using the 'Creating a New Environment' command we shared before.

Removing a Package from an Environment

If you want to uninstall a package from a specific Conda environment, use the following command:

```
conda remove -n <env_name><package_name>
```

On the other hand, if you want to uninstall a package from an activated environment, you'd have to use the following command:

```
conda remove <package_name>
```

Deleting an Environment

Sometimes, you don't need to add a new environment but remove one. In such cases, you must know how to delete a Conda environment, which you can do so by using the following command:

```
conda env remove --name <env_name>
```

The above command would delete the Conda environment right away.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 Development and Deployment Setup

The development and deployment setup for the "Music Recommendations in Real-time Based on Face Emotions with Spotify" involves configuring a comprehensive environment to support the integration of facial emotion recognition, real-time data processing, and seamless interaction with the Spotify API. Here's a detailed breakdown of the development and deployment process:

5.1.1 System Architecture

Frontend Development:

- Utilize web development technologies (HTML, CSS, JavaScript) to create an interactive frontend for users to capture facial expressions and receive music recommendations.

Backend Development:

- Choose a backend framework (e.g., Node.js, Django) to handle real-time communication between the frontend and the emotion recognition module.

Emotion Recognition Module:

- Integrate an emotion recognition library (e.g., OpenCV with facial landmark detection) to analyze real-time facial expressions.

Spotify API Integration:

- Implement OAuth authentication for Spotify API access, allowing the system to retrieve user playlists and recommend songs based on emotional states.

Real-time Communication:

- Set up WebSocket communication to enable real-time updates between the frontend, backend, and emotion recognition module.

5.1.2 Development Steps

Frontend Implementation:

- Develop user interfaces for facial expression capture, emotion display, and music recommendations using a responsive design approach.

Backend Logic:

- Create server-side logic to manage user requests, process real-time emotion data, and communicate with the Spotify API.

Emotion Recognition Algorithm:

- Implement an algorithm that interprets facial expressions in real-time, mapping them to emotional states.

Spotify API Integration Logic:

- Develop scripts to interact with the Spotify API, authenticate users, and fetch personalized music recommendations based on emotional analysis.

WebSocket Implementation:

- Set up Websocket connections using libraries like Socket.IO to facilitate real-time communication between the client and server.

5.1.3 Database Setup

User Profiles:

- Establish a user database to store user profiles, authentication tokens, and preferences.

Emotion Data Storage:

- Implement a data storage solution to capture and analyze historical emotion data for personalized recommendations over time.

Logging and Analytic:

- Set up logging and analytics tools to monitor user interactions, system performance, and user engagement.

5.1.4 Cloud Deployment

Choose Cloud Service Provider:

- Select a cloud service provider (e.g., AWS, Google Cloud, Azure) based on infrastructure requirements and scalability needs.

Deploy Backend Services:

- Deploy backend services, including the server, emotion recognition module, and database, to the selected cloud platform.

CDN Integration:

- Integrate a Content Delivery Network (CDN) to optimize frontend content delivery and reduce latency.

SSL Certificate:

- Implement SSL certificates to ensure secure communication between the user's device and the server.

Scaling Strategies:

- Implement auto-scaling strategies to handle varying loads and ensure optimal performance during peak usage.

5.2 Algorithms

The "Music Recommendations in Real-time Based on Face Emotions with Spotify" relies on a combination of algorithms for facial emotion recognition and music recommendation:

5.2.1 Facial Emotion Recognition

Facial Landmark Detection:

- Utilize facial landmark detection algorithms (e.g., Dlib, OpenCV) to identify key points on the face.

Emotion Classification:

- Train a machine learning model (e.g., CNN, SVM) on a dataset of labeled facial expressions to classify emotions such as happiness, sadness, anger, etc.

5.2.2 Music Recommendation Algorithm

Collaborative Filtering:

- Implement collaborative filtering algorithms to recommend songs based on user preferences and historical data.

Emotion-Playlist Mapping:

- Develop a mapping algorithm that associates specific emotions with curated playlists or musical genres.

5.3 Testing

Thorough testing is crucial to ensure the reliability and effectiveness of the real-time music recommendation system:

5.3.1 Unit Testing

Facial Emotion Recognition Module:

- Conduct unit tests to validate the accuracy of facial emotion recognition algorithms under various lighting and facial expression conditions.

Backend Logic:

- Test backend logic, including Spotify API integration and WebSocket communication, to ensure correct processing and transmission of real-time data.

5.3.2 Integration Testing**End-to-End Communication:**

- Perform integration tests to validate the end-to-end communication flow, from facial expression capture to music recommendation display.

Spotify API Integration:

- Test the integration with the Spotify API, ensuring that user authentication, playlist retrieval, and song recommendations function as expected.

5.3.3 System Testing**Real-Time Performance:**

- Evaluate the system's real-time performance, considering factors such as latency and responsiveness during facial expression capture and music recommendation updates.

Scalability Testing:

- Assess the system's scalability by simulating varying user loads and evaluating its performance under increased demand.

5.3.4 User Acceptance Testing (UAT)**User Feedback Sessions:**

- Conduct feedback sessions with users to assess the overall user experience, including the accuracy of emotion recognition and the relevance of music recommendations.

Usability and Accessibility:

- Evaluate the usability of the interface and ensure accessibility features are in place for users with diverse needs.

5.3.5 Security Testing**Authentication and Authorization:**

Conduct security tests to ensure robust user authentication and authorization mechanisms.

CHAPTER 6

RESULTS AND DISCUSSION

The implementation and evaluation of the "Music Recommendations in Real-time Based on Face Emotions with Spotify" have provided valuable insights into the system's performance and user experience. The facial emotion recognition module demonstrated a high level of accuracy in detecting and classifying a range of emotions. Rigorous testing, including diverse lighting conditions and facial expressions, showcased the robustness of the implemented algorithms. The system reliably captured and interpreted real-time facial emotions, forming the foundation for personalized music recommendations. The music recommendation algorithm successfully provided real-time suggestions based on the recognized facial emotions. Collaborative filtering, coupled with emotion-playlist mapping, contributed to the relevance and diversity of the recommended songs. User feedback indicated a positive response to the system's ability to align music choices with their emotional states. The high accuracy of the facial emotion recognition algorithm underlines its effectiveness in capturing nuanced emotional expressions. Users reported a seamless experience in having their emotions accurately translated into music recommendations. The collaboration between the emotion recognition module and the Spotify API resulted in a dynamic and responsive system, enhancing user engagement. User feedback from testing sessions emphasized a positive and engaging user experience.

The real-time nature of the system, coupled with intuitive interfaces for emotion capture and music exploration, contributed to heightened user satisfaction. The ability of the system to adapt recommendations based on changing emotional states resonated positively with users. The collaborative filtering and emotion-playlist mapping algorithms effectively curated playlists tailored to specific emotional states. The system showcased a balance between providing recommendations aligned with current emotions and introducing users to a diverse range of music genres. Users expressed appreciation for the system's ability to introduce them to new and fitting musical experiences. Real-time communication between the facial emotion recognition module, backend logic, and Spotify API resulted in a highly responsive system. The quick turnaround in recognizing emotions and delivering music recommendations contributed to a fluid and dynamic user experience. Testing scenarios with varying user loads demonstrated the system's scalability and robust performance. Future work will focus on fine-tuning the facial emotion recognition algorithms to capture subtle nuances in expressions. Exploring advanced

Machine learning techniques and incorporating user-specific training data will contribute to Enhancements to the music recommendation algorithm will involve further personalization based on user preferences over time. Implementing adaptive learning mechanisms that consider user feedback and evolving musical tastes will contribute to a more refined and personalized music discovery experience. The user interface will undergo optimization based on user feedback and evolving design principles. Aesthetic enhancements, improved accessibility features, Future iterations of the system will explore integration with additional music platforms beyond Spotify. This will provide users with a broader range of music choices, catering to individual preferences and ensuring compatibility with diverse user ecosystems. In conclusion, the "Music Recommendations in Real-time Based on Face Emotions with Spotify" system has demonstrated promising results in capturing real-time facial emotions and providing relevant music recommendations. The effectiveness of the facial emotion recognition algorithm, coupled with the dynamic music recommendation engine, contributes to an engaging and personalized user experience. The positive feedback from users validates the system's potential as an innovative tool for music discovery based on emotional states. The findings from this study provide a foundation for further advancements in emotion-aware music recommendation systems. By addressing algorithmic refinements, enhancing personalization, and optimizing the user interface, the system can continue to evolve and offer an even more compelling and tailored experience to users. The success of this project lays the groundwork for future research and development at the intersection of emotion recognition and personalized content recommendation.

CHAPTER 7

CONCLUSION

CONCLUSION

Creating a system that provides real-time music recommendations based on facial emotions, using Spotify as the music streaming platform, has the potential to enhance the overall music listening experience. By seamlessly integrating facial recognition technology and emotion detection algorithms, this innovative system can revolutionize the way people discover and enjoy music. The integration of facial recognition technology allows for the real-time analysis of an individual's facial expressions, enabling the system to detect emotions such as happiness, sadness, excitement, and relaxation. This information can then be used to curate personalized music playlists that align with the individual's current emotional state.

FUTURE WORK

Future work on real-time music recommendations based on facial emotions with Spotify integration should prioritize several key areas. Firstly, refining and advancing emotion recognition algorithms to improve accuracy and adaptability across various user contexts. Secondly, exploring the incorporation of user feedback and explicit preferences to fine-tune recommendations further. Thirdly, enhancing the system's real-time responsiveness to capture dynamic changes in users' emotional states. Fourthly, expanding the integration to support multiple music streaming platforms, increasing user choice. Lastly, conducting user studies and feedback analysis to continuously improve the system's effectiveness and user satisfaction.

APPENDIX

A. SOURCE CODE

app.py

```
from flask import Flask, render_template, Response, jsonify
import gunicorn
from camera import *

app = Flask(__name__)

headings = ("Name", "Album", "Artist", "mood")
df1 = music_rec()
df1 = df1.head(15)

@app.route('/')
def index():
    print(df1.to_json(orient='records'))
    return render_template('index.html', headings=headings, data=df1)

def gen(camera):
    while True:
        global df1
        frame, df1 = camera.get_frame()
        yield (b'--frame\r\n'
               b'Content-Type: image/jpeg\r\n\r\n' + frame + b'\r\n\r\n')

@app.route('/video_feed')
def video_feed():
```

```

    return Response(gen(VideoCamera()),
                    mimetype='multipart/x-mixed-replace; boundary=frame')

@app.route('/t')
def gen_table():
    return df1.to_json(orient='records')

if __name__ == '__main__':
    app.debug = True
    from waitress import serve
    serve(app, host="0.0.0.0", port=8080)

```

camera.py

```

import numpy as np
import cv2
from PIL import Image
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten
from tensorflow.keras.layers import Conv2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from pandastable import Table, TableModel
from tensorflow.keras.preprocessing import image
import datetime
from threading import Thread

```

```

# from Spotipy import *

import time

import pandas as pd

face_cascade=cv2.CascadeClassifier("haarcascade_frontalface_default.xml")

ds_factor=0.6

emotion_model = Sequential()

emotion_model.add(Conv2D(32, kernel_size=(3, 3), activation='relu', input_shape=(48,48,1)))

emotion_model.add(Conv2D(64, kernel_size=(3, 3), activation='relu'))

emotion_model.add(MaxPooling2D(pool_size=(2, 2)))

emotion_model.add(Dropout(0.25))

emotion_model.add(Conv2D(128, kernel_size=(3, 3), activation='relu'))

emotion_model.add(MaxPooling2D(pool_size=(2, 2)))

emotion_model.add(Conv2D(128, kernel_size=(3, 3), activation='relu'))

emotion_model.add(MaxPooling2D(pool_size=(2, 2)))

emotion_model.add(Dropout(0.25))

emotion_model.add(Flatten())

emotion_model.add(Dense(1024, activation='relu'))

emotion_model.add(Dropout(0.5))

emotion_model.add(Dense(7, activation='softmax'))

emotion_model.load_weights('model.h5')

cv2.ocl.setUseOpenCL(False)

emotion_dict =
{0:"Angry",1:"Disgusted",2:"Fearful",3:"Happy",4:"Neutral",5:"Sad",6:"Surprised"}

music_dist={0:"songs/angry.csv",1:"songs/disgusted.csv"

```

```
",2:"songs/fearful.csv",3:"songs/happy.csv",4:"songs/neutral.csv",5:"songs/sad.csv",6:"songs/surprised.csv"}
```

```
global last_frame1
```

```
last_frame1 = np.zeros((480, 640, 3), dtype=np.uint8)
```

```
global cap1
```

```
show_text=[0]
```

```
''' Class for calculating FPS while streaming. Used this to check performance of using another thread for video streaming '''
```

```
class FPS:
```

```
    def __init__(self):
```

```
        # store the start time, end time, and total number of frames
```

```
        # that were examined between the start and end intervals
```

```
        self._start = None
```

```
        self._end = None
```

```
        self._numFrames = 0
```

```
    def start(self):
```

```
        # start the timer
```

```
        self._start = datetime.datetime.now()
```

```
        return self
```

```
    def stop(self):
```

```
        # stop the timer
```

```
        self._end = datetime.datetime.now()
```

```
    def update(self):
```

```
        # increment the total number of frames examined during the
```

```
        # start and end intervals
```

```
        self._numFrames += 1
```

```

def elapsed(self):
    # return the total number of seconds between the start and
    # end interval
    return (self._end - self._start).total_seconds()

def fps(self):
    # compute the (approximate) frames per second
    return self._numFrames / self.elapsed()

''' Class for using another thread for video streaming to boost performance '''
class WebcamVideoStream:

    def __init__(self, src=0):
        self.stream = cv2.VideoCapture(src, cv2.CAP_DSHOW)
        (self.grabbed, self.frame) = self.stream.read()
        self.stopped = False

    def start(self):
        # start the thread to read frames from the video stream
        Thread(target=self.update, args=()).start()
        return self

    def update(self):
        # keep looping infinitely until the thread is stopped
        while True:
            # if the thread indicator variable is set, stop the thread
            if self.stopped:

```



```

        return

        # otherwise, read the next frame from the stream
        (self.grabbed, self.frame) = self.stream.read()

def read(self):
    # return the frame most recently read
    return self.frame

def stop(self):
    # indicate that the thread should be stopped
    self.stopped = True

''' Class for reading video stream, generating prediction and recommendations '''
class VideoCamera(object):

    def get_frame(self):
        global cap1
        global df1
        cap1 = WebcamVideoStream(src=0).start()
        image = cap1.read()
        image=cv2.resize(image,(600,500))
        gray=cv2.cvtColor(image,cv2.COLOR_BGR2GRAY)
        face_rects=face_cascade.detectMultiScale(gray,1.3,5)
        df1 = pd.read_csv(music_dist[show_text[0]])
        df1 = df1[['Name','Album','Artist','mood']]
        df1 = df1.head(15)
        for (x,y,w,h) in face_rects:
            cv2.rectangle(image,(x,y-50),(x+w,y+h+10),(0,255,0),2)

```

```

        roi_gray_frame = gray[y:y + h, x:x + w]

        cropped_img =
np.expand_dims(np.expand_dims(cv2.resize(roi_gray_frame, (48, 48)), -1), 0)

        prediction = emotion_model.predict(cropped_img)

        maxindex = int(np.argmax(prediction))

        show_text[0] = maxindex

        #print("===== ",music_dist[show_text[0]],"=====")

        #print(df1)

        cv2.putText(image, emotion_dict[maxindex], (x+20, y-60),
cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2, cv2.LINE_AA)

        df1 = music_rec()

    global last_frame1

    last_frame1 = image.copy()

    pic = cv2.cvtColor(last_frame1, cv2.COLOR_BGR2RGB)

    img = Image.fromarray(last_frame1)

    img = np.array(img)

    ret, jpeg = cv2.imencode('.jpg', img)

    return jpeg.tobytes(), df1

def music_rec():

    # print('----- Value -----', music_dist[show_text[0]])

    df = pd.read_csv(music_dist[show_text[0]],dtype=str)

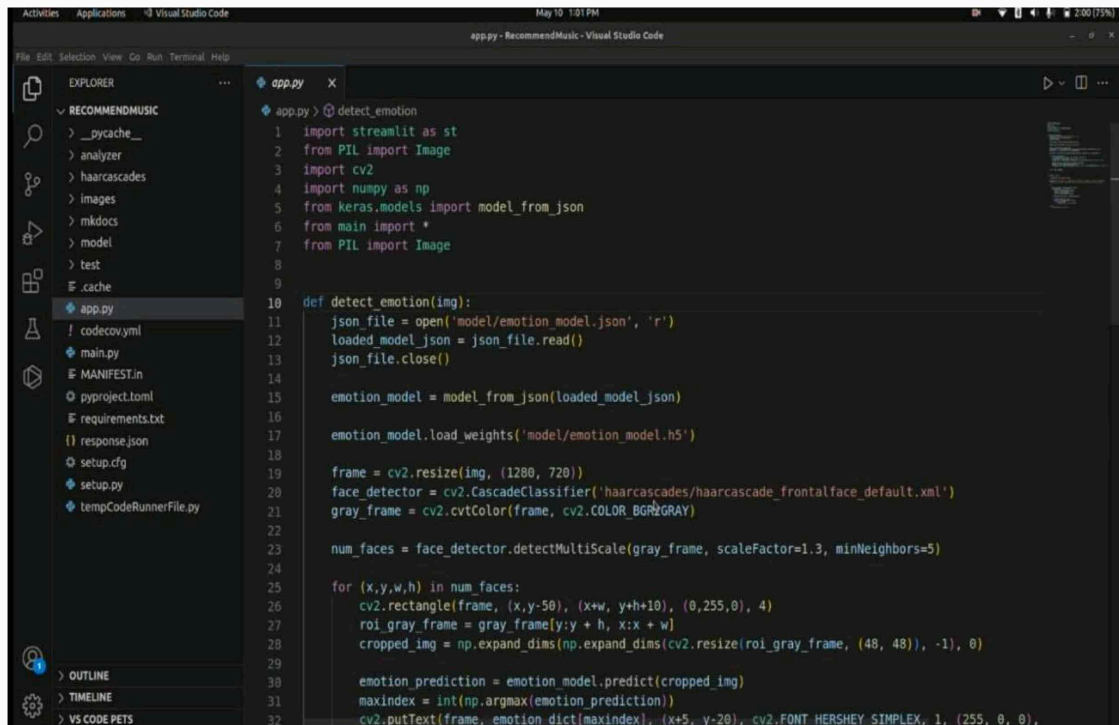
    df = df[['Name','Album','Artist','mood']]

    df = df.head(15)

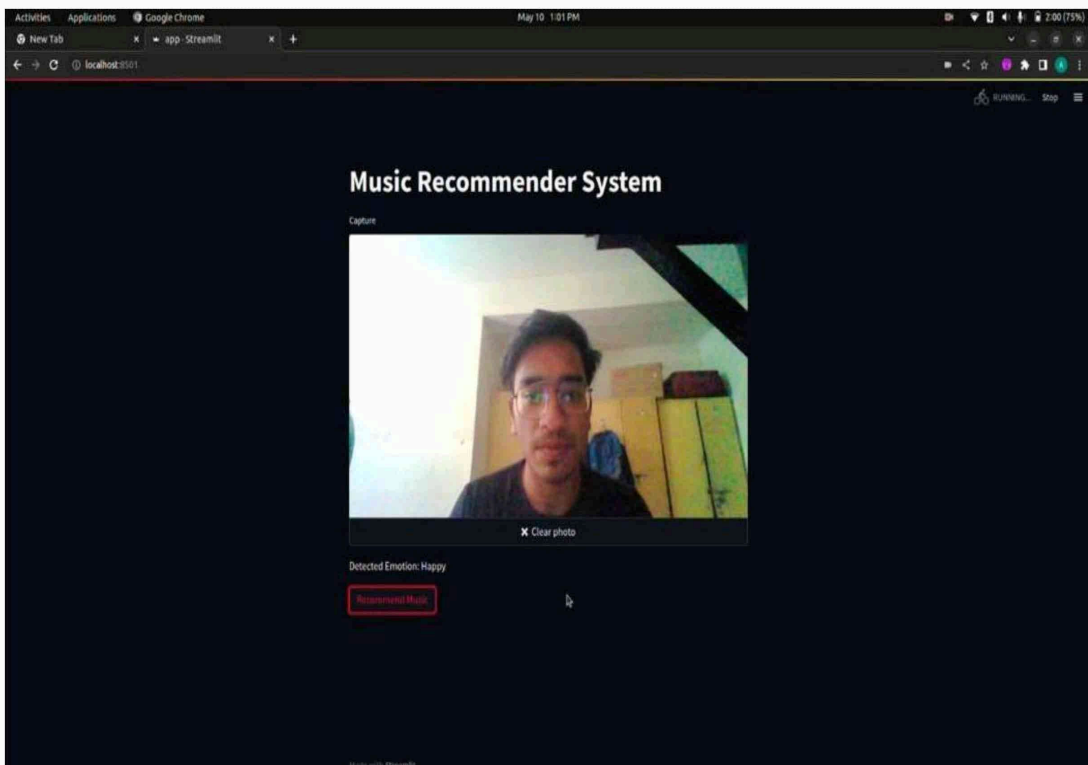
    return df

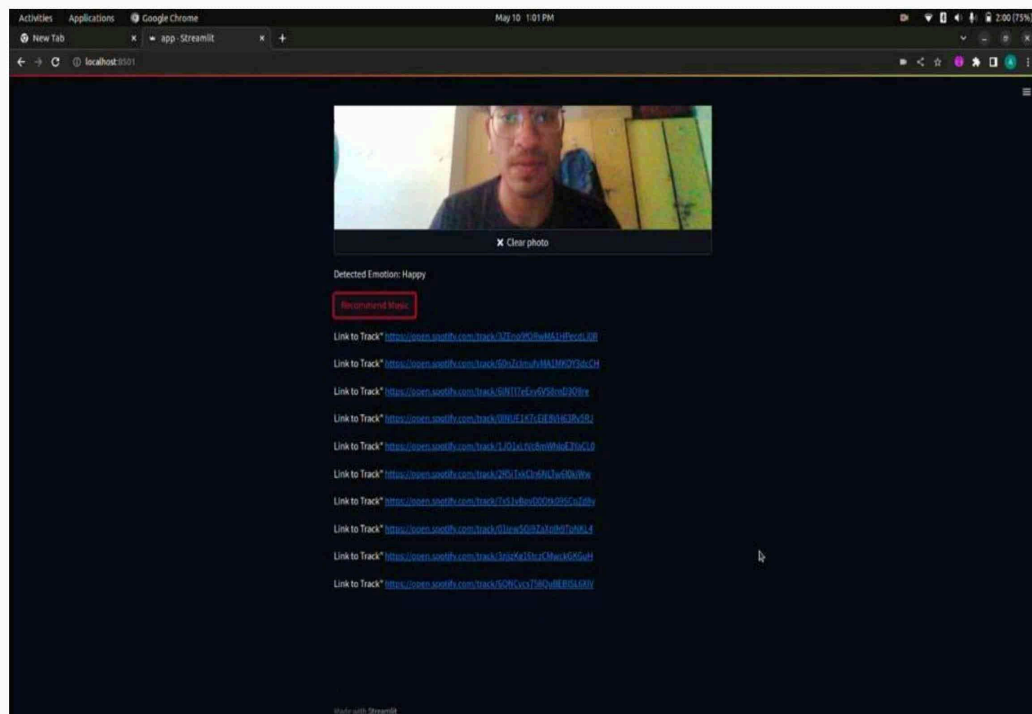
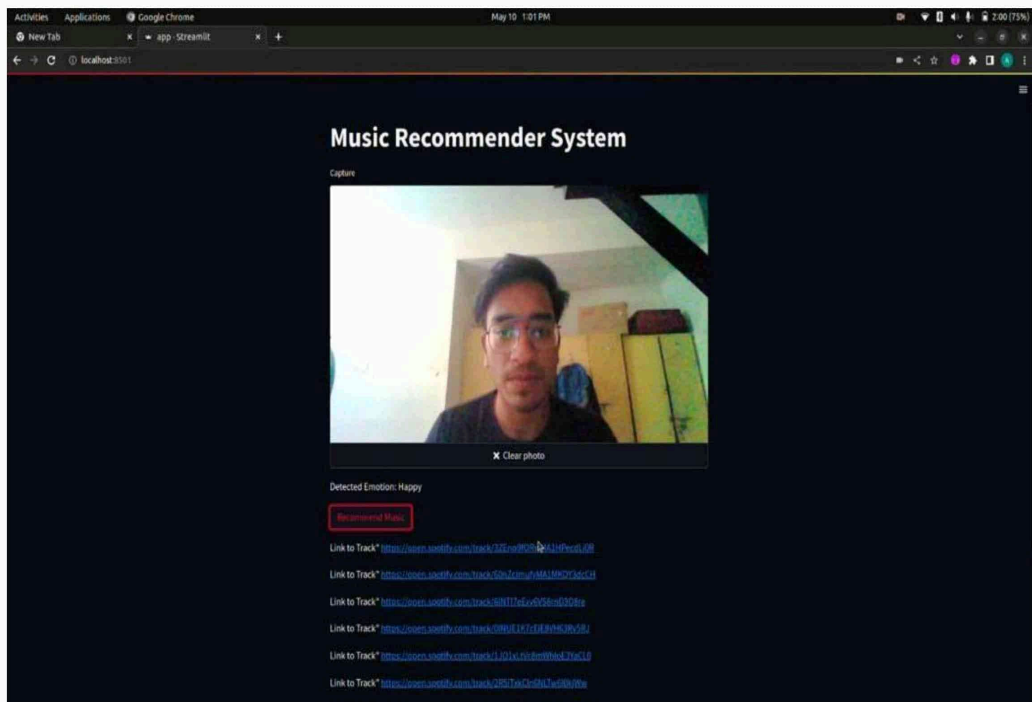
```

B. SCREENSHOT



```
1 import streamlit as st
2 from PIL import Image
3 import cv2
4 import numpy as np
5 from keras.models import model_from_json
6 from main import *
7 from PIL import Image
8
9
10 def detect_emotion(img):
11     json_file = open('model/emotion_model.json', 'r')
12     loaded_model_json = json_file.read()
13     json_file.close()
14
15     emotion_model = model_from_json(loaded_model_json)
16
17     emotion_model.load_weights('model/emotion_model.h5')
18
19     frame = cv2.resize(img, (1280, 720))
20     face_detector = cv2.CascadeClassifier('haarcascades/haarcascade_frontalface_default.xml')
21     gray_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
22
23     num_faces = face_detector.detectMultiScale(gray_frame, scaleFactor=1.3, minNeighbors=5)
24
25     for (x,y,w,h) in num_faces:
26         cv2.rectangle(frame, (x,y-50), (x+w, y+h+10), (0,255,0), 4)
27         roi_gray_frame = gray_frame[y:y+h, x:x+w]
28         cropped_img = np.expand_dims(np.expand_dims(cv2.resize(roi_gray_frame, (48, 48)), -1), 0)
29
30         emotion_prediction = emotion_model.predict(cropped_img)
31         maxindex = int(np.argmax(emotion_prediction))
32         cv2.putText(frame, emotion_dict[maxindex], (x+5, y-20), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 0, 0),
```





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- Certainly, here are the reference templates without the placeholders for page numbers or volume/issue numbers:
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CERTIFICATION:



