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Mood-Based Song Recommendation System

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Abstract. A study of existing music systems showed that many music applications fail to recommend songs based on emotion; instead, they use the user's history to recommend songs. The objective of this research work is to extract emotions from real-time input of the human face and suggest Bollywood songs based on the detected emotion and other factors. According to the results of the survey taken for this research work, users tend to listen to songs considering factors, genres, era, singer, time of the day, and activity. The requirements for the proposed system were the preparation of the dataset and finding relationships between different factors considered for the research work. The proposed system includes identification of emotion from the human face and song filtration based on the algorithm developed using the factors considered. Thus, the proposed system is an interactive mood-based songs recommendation system that considers the current emotion of the user along with vital factors related to songs and user preferences for these factors while recommending songs. In future, this song recommendation system can be improved by adding a bigger dataset of Bollywood and regional songs in major Indian languages.

Keywords: Emotion Detection, Songs Categorization, Recommendation, Content-based Filtering, Genres.

1 Introduction

Music is an interesting part of life for being human, starting from the earliest stages of life. For example, an infant's attention can be held easily by singing rather than by speech. Moreover, the adults have reported listening to music for expressing emotions and regulating their emotive state. It seems that music's prevalence is related to emotions [24]. The psychological research supports the association between songs to listen and mood of the user. Also, it can be used in various medical treatments as it is used to be a stress reliever. In many workplaces music is used to keep employees motivated and happy [11]. Music Therapy is used to treat the traumatic patients.

The music systems that exist today play songs, which are selected manually by users or are recommended based on users' earlier preferences and, based on collaborative-

based filtering [2]. Some music applications provide playlists that are created for different scenarios. For example, Spotify provides playlists for everyone, which are categorized based on genres and moods. Spotify and Saavn provide facilities to manually create their own playlists for users. But, segregating the playlists and annotating songs manually is quite time-consuming and laborious [9]. The system proposed in this research paper, is a recommendation system based on content-based filtering that seeks to predict the preference that the user would give to a song in an available playlist. For this prediction, the system utilizes vital factors related with music, along with user profile as well as user preferences. Some of these factors are collected through a user survey.

There are several recommendation systems which use factors like daily activity, time of the day and genre [1]. However, no such recommendation system has been developed which integrates the important metadata of songs and makes recommendations based on the integrated data. Also, recommendations based only on the context of songs are less effective. In addition to the context of songs, emotions of users should also be considered, to make recommendations more powerful. The novel approach is used to develop the proposed system which recommends songs based on integrated metadata of songs, important factors that influence selection of songs and emotions. Also, this system focuses on the basic needs of music enthusiasts as existing applications are troubling a lot for users: it uses technology to increase the interaction of the system with the user in many ways.

Music is a part of human life. Music is the language of the universe. Music can have considerable effects on cognition, emotion, and behavior. It also indicates that people use music to serve various functions, from emotion regulation and self-expression to social bonding. Therefore, the mood-based song recommendation system can be utilized as a virtual mood assistant that can help people feel better anytime [21]. Beyond just feeling good, having a better mood has other advantages. When users join their office in the morning, the system can recommend a list of Bollywood songs as background music, containing soothing melodies or recharge songs with happy or soul funk genre. This type of music in the morning or at start of weekday, can increase employee satisfaction, reduce anxiety at work, and contribute to their overall health. Also, it makes user mentally more creative. Depending on the pitch of the song, it can alter heart rate, breathing rate and blood pressure [15]. When people listen to high-pitched songs while exercising, their physical performance improves as music is said to be a good option to learn new things quickly and their consciousness of exertion decreases. Music is a powerful therapy that will make you calm down and in the moment of joy, it will make you cheerful. People who listen to low bass songs while studying, on the other hand, can boost their memory. Moreover, music develops the mind and boosts your self-confidence. They can also outperform students who study in silence or in a noisy environment. Not only happy songs lift up your mood, but also sad songs can heal wounds. When someone is in a bad mood, listening to sad songs can bring him pleasure and comfort. According to some doctors, music therapy has been a great

source of help for them in the treatment of health issues like dementia, depression, anxiety or trauma. Music can be used to calm patients with mental illness or depression. People can cope with their pain by listening to music. People suffering through physical pain can experience less pain after listening to music. There are many children with a learning disability, who have responded positively to the music therapy [6]. Thus, music plays a more important role in our life than just being a source of entertainment. The mood-based song recommendation system can also be used in music therapy. The mood-based song recommendation system can have many positive effects on human body, mind, and overall health.

In this research paper, based on the results of the user survey taken, six factors which are emotion, singer, era, genre, time of the day and activity are considered for recommendation of songs. Users tend to listen to specific genres of songs in different emotions, activities and time of the day [23]. The proposed mood-based songs recommendation system is an interactive system made for entertainment of users. In interaction with users, the system takes user's information about his / her preferences for genres, era and singers at the time of registration into the system, which can be modified by the user anytime. Using this system, users can get recommendations based either on emotion or activity which he is performing. The emotion is extracted by capturing real time images [5]. Based on the preference decided by system and preference for genres in the user's profile, system selects two genres which can satisfy both system's and user's preferences simultaneously. The system filters out songs according to the selected genre and era in the user profile. The selected songs are then sorted such that songs of preferred singers will come at the top. These sorted songs are then recommended to the user.

2 Related Work

During the research work related to the song-recommendation system, following research papers and reports have been studied.

In 2013, the International Conference on Machine Learning (ICML) organized the competition – ‘Challenges in Representation Learning’ in which one of the challenges was ‘The Facial Expression Recognition Challenge’ to find the effective algorithm for emotion detection from the human face. A brief report on challenges and top submissions of this competition is available now [12]. For this challenge, the dataset ‘FER-2013’ containing 35887 images, was created by Carrier P. and Courville A. Out of 56 submissions, top 3 submissions used Convolutional Neural Network (CNN) and the winner used Support Vector Machine (SVM) as a loss function to train the model. The results showed the importance of SVM-loss function in facial emotion detection. Using the similar method for recognizing emotions from human faces, Akhtar R. created the facial-emotion-recognition package in Python which creates a bounding box around the face of the person present in the picture and puts a text at the top of the bounding box representing the recognized emotion [10]. This package is indeed highly accurate tool for detection of emotions.

In the next study titled ‘A Survey of Affect Recognition Methods: Audio, Visual, and Spontaneous Expressions’, the existing emotion detection systems use only intentionally displayed and overemphasized expressions of first emotion [27]. But human behavior can differ in visual look, audio profile, and timing from naturally occurring behavior. This research describes various factors in human emotion detection. On the bases of this paper the user survey questionnaire is designed. The paper surveys the different factors to analyze human mood. Similar user survey has been conducted to understand factors that differ from person to person while regulating emotions.

In addition to earlier systems Mortensen M. et. al. [17] gathered mood ratings of both music and users explicitly. So, this recommender system is positively evaluated using real-world data in a live implementation, with live users interacting with the system using collaborative-filtering.

The system proposed by Bansal D. et. al. [3] was developed to capture physiological signals from the user via a wearable computing device. By using these signals, it enhanced the accuracy of the recommendations made by the recommender system by tracking the user’s emotional state through these signals. Using this device, the proposed system can be enhanced. In this proposed system, Emotional effects of the past recommendations on the user are stored in the system’s database and used in future recommendations, as the same musical track’s effects can be varied between different users. In the paper by Kabini H. et. al. [14], they have discussed the fact that visual appearance and audio profile affect human behavior. They have discussed human emotion perception from a psychological perspective. This perspective is taken in count while creating the algorithm of this system.

To develop emotion-based music recommendation system, Bhutada S. et. al. [5], assigned an emotion to every song and filtered songs according to the detected emotion. Whereas Dureha A. [8] used an audio emotion recognition algorithm and generated playlists of songs for different emotions. Songs are then filtered based on the current emotion of human and emotions of songs. Filtered songs are recommended to the user. Combining these two approaches in the proposed system, genre is assigned to every song in the dataset. Songs are then categorized according to labelled genres to create playlists.

A lot of work has been done in the field of emotion detection and mood-based songs classification. The demand is for a better approach to recommend songs. Andjelkovic I. et. al. [1] has developed the hybrid recommender system named Mood play, which makes recommendations based on both contexts of songs and mood of the user. This system uses an interactive interface to take real time input from the user. Based on input taken at the recommendation time and pre-existing data in the user profile, songs get recommended. The proposed system uses a similar approach of creating a user profile and taking input at real time to make the system interactive. The system which has been proposed, not only concentrated on User experience but also on accuracy.

To improve the accuracy of Facial Emotion Detection (FER), Gala P. et. al. [11] propose a system work which makes use of Viola-Jones (VJ) algorithm with Principal Component Analysis approach to extract essential facial features. The accuracy of the FER system only depends upon the extracted features during processing. The final outcome of this system attains an accuracy level of about 86.67%. This algorithm can be used for FER.

In 2017, Cook T. et. al. [8], conducted the user survey of 794 university students to study their music preferences while regulating emotions. This study provides a quantitative analysis of the relationship between different genres and three categories of emotions. Related results are used to develop the algorithm for the proposed system.

To develop a mood-based songs recommendation system, existing techniques [8, 12, 27] in the field of emotion detection, emotion regulation and songs recommendation are studied. Results and analysis of relationships between different genres and emotions are studied to develop the algorithm for the proposed system. During the literature survey, drawbacks in the existing music applications and different approaches for the development of the mood-based songs recommendation system are analyzed.

3 Research Methodology

This section discusses several research activities that have been conducted during design of the proposed Mood-Based Song Recommendation System. These activities involve user survey, dataset preparation, emotion detection and design of the proposed system.

3.1 User Survey

To analyze the weight of various factors in recommending songs, a collection of rich opinions of potential end users was required. A user survey has been conducted for this research work, to know factors that users consider while selecting songs in different moods. This survey collected the users' experiences and their expectations from the music applications. The relationships and dependency among factors from the results of the user survey has been observed and listed down [4]. These relationships are used at the time of developing the algorithm for filtration of songs.

3.2 Dataset Preparation

The dataset containing all the factors gathered during the user survey was not available anywhere. So, a dataset of songs has been prepared by performing web-scraping and extracting the required information from the web. Since the extracted data was in raw format, some data cleaning techniques have been applied.

3.3 Emotion Detection

With the help of results of the user survey, the sequence of factors based on which filtration occurs, the contents of the user profile, inputs to be taken from the relevant user during the registration process and inputs to be taken during the use of the system by the user has decided. And finally the algorithm for the filtration of songs based on the current mood of the user and activity performed by the user, has been designed.

4 User Survey

This section describes the purpose of taking the user survey and results acquired through it about factors influencing mood, their sequences and priorities while recommending songs.

4.1 Purpose

User survey was an important part when designing the mood-based song recommendation system to understand the user's experience as well as perception about the current music applications and song selection. The purpose of this survey was to gain knowledge about factors that users consider while selecting songs, sequence of those factors, to know the most listened genres and the other features that they expect from the music applications.

4.2 User Profile

The survey of 100 users has been taken for this research work, where users were given the questionnaire designed with Zoho Survey [28] to fill in the first few questions asked for the personal information like user age and gender. Then, next few questions were to know the user interest and knowledge level of music. Further questions were asking for personal preferences from users about their choices in era, genres and pitch of songs. At the end, the questions were asked to understand user preferences regarding the factors affecting the selection of the songs.

* What factors do you consider while selecting songs?
 (Suppose you are given 10,000 songs and you are asked to choose 5 songs among them that you would like to listen to at that moment. Select factors from the following that you would apply to filter 5 songs out of 10,000 songs.)

Emotion
 Actor
 Type of Music (Classical, Hip-hop, Rap and others)
 Activity (such as Travelling, Cooking, Reading, Driving)
 Dance Moves
 Other (Please specify)

Singer
 Era (Late 90's, Early 20's, Present 20's)
 Time of the day (Morning, Night and other)
 Shooting Site

* In what sequence do you apply factors for selection of songs?

Emotion
 Singer
 Actor
 Era
 Type of music
 Time of day
 Activity
 Shooting Site
 Dance Moves

* According to you what primary factors should be considered for songs selection?

Emotion
 Actor
 Type of music
 Activity
 Dance moves
 Other (Please specify)

Singer
 Era (Years)
 Time of day
 Shooting site

* According to you what secondary factors should be considered for songs selection?

Emotion
 Actor
 Type of music
 Activity
 Dance moves
 Other (Please specify)

Singer
 Era (Years)
 Time of day
 Shooting site

Fig. 1. Section of Questionnaire related with Factors used in Selection of Songs

Fig. 1 shows some questions asked in survey regarding preference about factors and whose responses were highly important for the development of the proposed system. In the user survey, user profiles and comprehensive participation is an important aspect [21]. In the survey, 51% users were in the age group of 0 - 20 years, 38% users were in 20 - 40 years and remaining 11% users were above 40 years. About 55% male and 45% females participated in the user survey. The results of this survey are drawn by mainly focusing on the responses of those users, who spend more time listening to music than normal crowd. We got 21% users listening to songs for less than 2 hours, 77% users listening for 2 - 5 hours and 2% users listening for more than 5 hours. Responses of

33% users having skills in music were compared with that of 67% users not having skills in music. These profiles played an important role in the analysis of the user survey.

4.3 Survey Result

Among the different factors - emotion, singer, genre, activity, era and/or time of day are the most preferred factors for selecting songs, as seen in Fig.3. This is reflected in higher user preference in terms of a greater number of users selecting a specific factor. Users were also given freedom to select as many factors as per their aspiration.

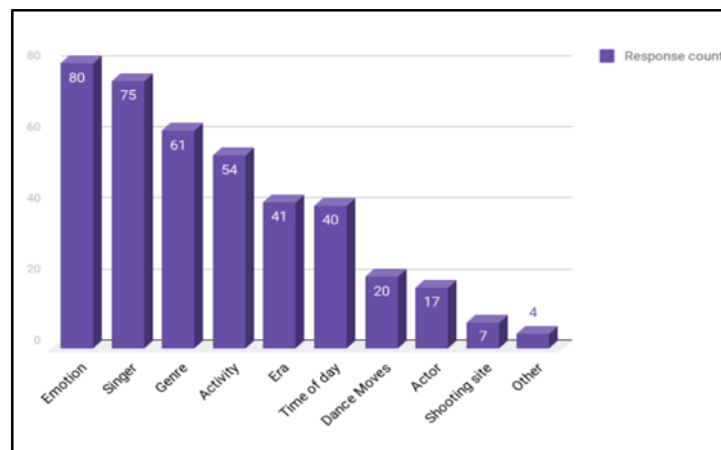


Fig. 2. Factor Preferences (in Selection of Songs) given by Users during the Survey

Users have given preference to genres such as Soul/ Funk, Dance, Classical, Rap / Hip-hop, Pop and Jazz. This is reflected in higher user preference in terms of a greater number of users opting for a specific genre. The bar graph in Fig. 3 shows that users hardly listen to other genres.

From the results, six factors have been considered which are emotion, singer, genre, era, activity and time of day to recommend songs. Also, the six genres selected, include - Soul/ Funk, Dance, Classical, Rap / Hip-hop, Pop and Jazz.

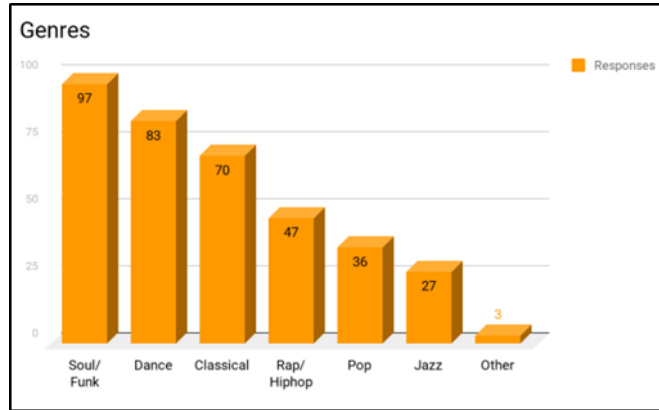


Fig. 3. Genre Preferences (in Selection of Songs) given by Users during the Survey

5 Dataset Preparation

Results of experimentation gain accuracy if the dataset is relevant and larger. With a smaller dataset, filtration considering six factors would have become too difficult and non-effective as there was a need for the dataset containing sufficient number of songs.

According to the survey conducted for this research work, most of the users participated in the survey prefer to listen to Bollywood songs – famous in India. There was a need for a dataset of Bollywood songs with a variety of features like its era, singers, genres and other parameters. Off-the-self dataset consisting of all these features, was not readily available. So, this own updated song dataset has been prepared with due consideration of selected factors as seen in Fig. 4. This section describes the dataset schema, data collection through web-scraping and related data cleaning methods.

song_name	year	singers	lyricist	composer	movie_name	movie_director	actors	genre
Rabhasi	2018	Blazej Kallash Kher Nikash Aziz	Abbas Tyrewala	A.R. Rahman	2	S. Shankar	Rajnikanth Akk	Dance
Mechanical Sundarya	2018	Armaan Malik Shaahna Trupati	Abbas Tyrewala	A.R. Rahman	2	S. Shankar	Rajnikanth Akk	Pop
Wo Pehli Mulaqaat	1946	Surendra	Shevan Rizvi	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Dance
Jhamak Jhamak Liye Teg Tamak	1946	Shamshad Begum	Yashodanandan Joshi	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Classical
Dilli Tere Qile Par Honge	1946	Chorus	Shevan Rizvi	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Classical
Chupke Hi Chupke Na Jaane	1946	Khan Mastana Rajkumar Dubeey	Angum Pilibhiti	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Pop
Meri Ho Gayi Unse Beat	1946	Suraya Jamaal Sheikh (Suraya)	Shevan Rizvi	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Classical
Umedon Ka Tara	1946	Suraya Jamaal Sheikh (Suraya)	Angum Pilibhiti	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Classical
Gham E Ashiyana Satayega Kab	1946	Suraya Jamaal Sheikh (Suraya)	Mohan Singh	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Classical
Teri Nazar Mein Main Rahu	1946	Suraya Jamaal Sheikh (Suraya) Surendra	Shevan Rizvi	Sajjad Hussain	1857	Mohan Sinha	Nigar Sultana	S Pop
Vaada Tumse Hain Vaada	2008	Pandit Jasraj	Sameer	Adnan Sami	1920	Vikram Bhatt	Rajneesh Duggal	Rap Hiphop
Tujhe Main Pyar Karu	2008	Kallash Kher	Sameer	Adnan Sami	1920	Vikram Bhatt	Rajneesh Duggal	Rap Hiphop
Bichua	2008	Shubha Mudgal	Sameer	Adnan Sami	1920	Vikram Bhatt	Rajneesh Duggal	Dance
Aise Jatta Hai Jiye	2008	Asha Bhosle	Sameer	Adnan Sami	1920	Vikram Bhatt	Rajneesh Duggal	Pop
Aanevale Kal	2018	Rahul Jain	Shakeel Azmi	Harish Sagane	1921	Vikram Bhatt	Zarine Khan	Kai Soul Funk
Kuch Iss Tarah	2018	Arnob Dutta	Shakeel Azmi	Harish Sagane	1921	Vikram Bhatt	Zarine Khan	Kai Soul Funk
Yaara	2018	Arnob Dutta	Shakeel Azmi	Harish Sagane	1921	Vikram Bhatt	Zarine Khan	Kai Soul Funk
Teri Bina	2018	Aakanksha Sharma Anjli Singh	Raqeeb Alam	Asad Khan	1921	Vikram Bhatt	Zarine Khan	Kai Soul Funk
Sumi Le Zara	2018	Arnob Dutta	Shakeel Azmi	Harish Sagane	1921	Vikram Bhatt	Zarine Khan	Kai Pop
Kaal Ka Antim Palon Tak	2007	Various Artists	Dr. Devedra Nath	Alakh Sagar	1971	Amrit Sagar	Manoj Bajpai	R Classical
Sehenge Hum	2007	Shibani Kashyap	Zakir Husain	Alakh Sagar	1971	Amrit Sagar	Manoj Bajpai	R Soul Funk
O Tere Saath Saath Meri	1956	Lata Mangeshkar	Rajendra Krishan	Ramchandra Narhar Chitalkar (26 January		Ramesh Sagal	Aj I	Nalini Jayvi Pop
Phir Dharti Par Aa Jaa Re	1956	Asha Bhosle Prabhod Chandra Dey (Manna Dey)	Rajendra Krishan	Ramchandra Narhar Chitalkar (26 January		Ramesh Sagal	Aj I	Nalini Jayvi Soul Funk
Ro Ro Ke Dil Pukare	1956	Lata Mangeshkar	Rajendra Krishan	Ramchandra Narhar Chitalkar (26 January		Ramesh Sagal	Aj I	Nalini Jayvi Soul Funk
Aankh Royi Magar	1956	Lata Mangeshkar	Rajendra Krishan	Ramchandra Narhar Chitalkar (26 January		Ramesh Sagal	Aj I	Nalini Jayvi Soul Funk
Sone Ki Jahan	1956	Lata Mangeshkar	Rajendra Krishan	Ramchandra Narhar Chitalkar (26 January		Ramesh Sagal	Aj I	Nalini Jayvi Soul Funk

Fig. 4. Song Dataset prepared with Relevant Fields

5.1 Schema of Dataset

The dataset was prepared for its reusability in future, even if additional filtering features may be added or extracted as per system requirements in the future. The dataset consisted of total 9 columns as depicted in Fig. 4. These columns are related with fields such as song name, era, singer(s), genre, lyricists, music composer(s), movie name, movie director and actor(s). The information of songs will be displayed on the screen while playing particular songs or in future filtration based on these fields. This information includes the fields - lyricists, music composer, movie name, movie director and related actors. Therefore, it was necessary to include these fields in the dataset prepared.

5.2 Data Collection through Web-Scraping

The technique of web-scraping was used to collect sufficient amounts of song data for the preparation of dataset. A ParseHub tool was used for web-scraping to collect information from any dynamic website into Spreadsheets files which later converted into Comma Separated Value (CSV) files [20]. The content for the dataset was collected from a site named Lyrics Bogie [16]. A total of about 4200 Bollywood songs have been collected using web-scraping. Fig. 4 shows the schema of dataset and format of data collected.

5.3 Data Cleaning Process

As the data collected through web-scraping was in raw format, data cleaning process was applied on the data. The data cleaning processes included removing extra white spaces and removing Uniform Resource Locator (URLs) of all the songs. The additional commas in the column - 'singers', could have caused problems, while converting dataset files in CSV format. Thus, commas were replaced by | (or) sign. Genres obtained by web-scraping were not so useful and accurate. Therefore, the genres were entered manually during preparation of a dataset.

6 Machine Learning Aspects

A recommendation system is a system which recommends relevant choice or decision based on factors chosen by the user. This system will recommend the most likely songs to the user, based on the factors - emotion, singer, genre, era, activity and time of day. Most of the applications like Saavn, Ganna and Spotify, use the recommendation system to predict the most likely song, based on the user's history [18].

This recommendation system is based on content-based filtering. It processes a huge amount of data considering the user's preference and interest. This system, initially, detects the human face from the captured image. It locates the face, and binds it within a box to crop it. Then, it converts the cropped image into grayscale. On the grayscale image, facial key-points get located. According to positions of the located facial key-

points, SVM classifiers detect the emotion. The system uses the detected emotion for song filtration. Filtration of songs considering emotion and other six factors is implemented using the relationships and dependency among the factors. Next part of this section discusses the relationships among six factors and their usefulness while developing algorithms for the proposed system.

6.1 Relationship among Factors considered for Recommendation of Songs

From the results of the user survey, the major factors contributing in selection of songs are selected. These factors include - genre, singer, era, emotion, activity, time of day. Among these factors, an emotion and activity are poorly related to each other. Users either choose activity-based songs or emotion-based songs at a time. Genre is a factor which has relation with the most of the other factors. A particular singer always sings songs of some specific genres. In different emotions, genres of different bass get preferred. Preferences for genres get changed according to time of the day and the activity. Users listen to genres that they like and rarely listen to other genres.

6.1.1 Priorities for Genres according to Emotions

There are three types of emotions. These three categories include - positive emotions, energy-driven emotions (which can lead to arousal) and negative emotions [8]. Table 1 shows a short list of emotions, along with their category.

Table 1. List of Emotions, along with Their Category

No	Name of Emotion	Category of Emotion
1	Happy	Positive
2	Surprise	Positive
3	Anger	Energy-driven/Arousal
4	Sad	Energy-driven/Arousal
5	Fear	Negative
6	Contempt	Negative
7	Disgust	Negative

According to the survey taken by Cook T. et. al. [8], the preferences given by users to different genres during emotion management process are shown in Table 2.

Table 2. Genre Precedents for Regulation of Emotions

Preference	Positive Emotions	Energy-driven Emotions	Negative Emotions
High	Soul/Funk	Dance	Soul/ Funk
	Jazz	Rap/Hip-hop	Classical
To	Dance	Soul/Funk	Jazz
	Rock	Pop	Pop
Low	Rap/Hip-hop	Rock	Rap/Hip-hop
	Classical	Classical	Dance

6.1.2 Recommendation of Genres as per the Phase of the Day

For the proposed song recommendation system, the songs have been classified into three types according to the pitch of songs, which includes - High bass songs, Medium bass songs and Low bass songs as suggested by Swaroop S. [25]. Genres comprising these types of songs are shown in Table 3.

Table 3. Breakdown of Genres as per Bass of Songs

Energy-driven/High Bass Genres	Medium Bass Genres	Low Bass Genres
Dance	Soul/Funk	Jazz
Rap/Hip-hop	Pop	Classical

Table 4 shows the type of songs that should be recommended to users as per time of the day.

Table 4. List of Types of Songs Recommended as per Time of the Day

Phase of the Day	Time of the Day	Type of Songs
Early Morning	4:00 am -6:59am	Low Bass songs
Morning	7:00 am - 11:59 am	Energy-driven/ High bass songs
Afternoon	12:00 pm -3:59 pm	Low bass songs
Evening	4:00 pm -7:59 pm	Mediumbass songs
Night	8:00 pm – 3:59 am	Low bass songs

6.1.3 Interpretation for Genres as per User Activities

During this research work, the classification of activities has been done into three types as suggested by Sloan J. [26]. The categorized user activities are shown in Table 5. Type 1 activities are those which need lots of energy like walking/ running, exercising,

partying and others. Since high bass genres lead to arousal, they are preferred for this type of activity. Type 2 activities are those which require concentration and focus like reading, studying and meditating. According to Elizabeth Hoyt [13], listening to low bass genres can make us calm and can increase our focus; whereas high bass genres can distract us from our work and decrease our productivity. Hence, low bass genres are preferred for Type 2 activities. Type 3 activities are those which require neither much energy nor much concentration like household chores, daily activities like brushing teeth, cooking, travelling and doing some hobby related activities. Medium bass genres are preferred for these activities.

Table 5. Trifurcation of Activities

Type 1 (Energy)	Type 2 (Concentration)	Type 3 (Others)
Walking/Running	Study/Work	Household chores
Partying	Meditation	Cooking
Exercising		Travelling
		Hobby related activities

6.2 Proposed System

Mood-based song recommendation system provides interaction between users and the music system. The main aim of this system is to recommend songs concerning current emotion or activity. Whenever the user opens this system for the first time, user has to complete the profile by providing their own preferences for era, genres and singers of songs. Users can select multiple eras, genres and singers. System gives three eras to select that are Mid 90's, Early 20's and present 20's songs. Then, the system asks the user to select his preferred genres out of six genres (Soul/Funk, Dance, Classical, Jazz, Pop and Rap/ Hip Hop). The system, then, successively filters out singers in the preferred era and singers singing genres preferred by the user. The filtered list will be given to the user, from which the user has to select his preferred singers. The information about era, genres and singers given by the user, will be saved to the user's profile. Fig. 5 shows contents of user profile.

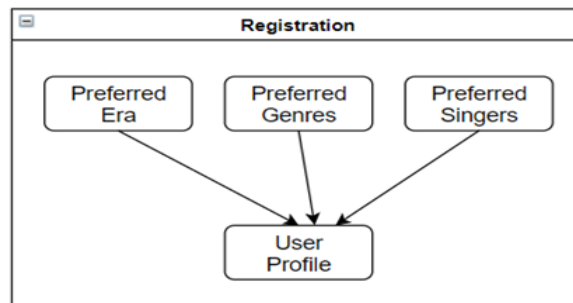


Fig. 5. Preferences Accepted through User Profile during Registration

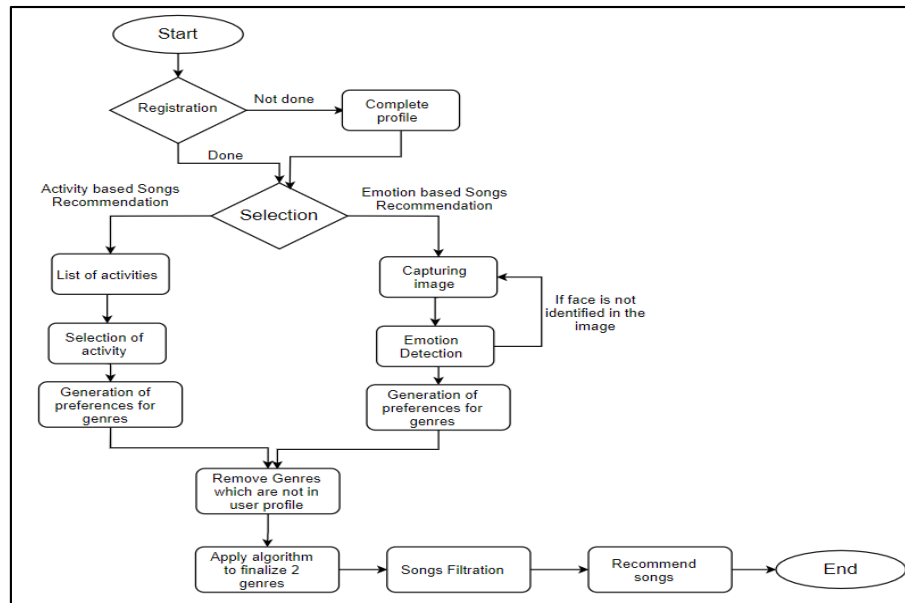


Fig. 6. Flowchart for Song Filtration Process

If the registration has completed already, the system asks the user whether one wants to listen to songs based on emotion or activity. If the user selects emotion, the system will extract emotion from the user's face image. Whereas on the selection of activity, the system provides a list of activities mentioned in the Table 5. Using Table 5, the system decides the type of activity that the user is doing while listening to the songs. Then, the system checks the current time and decides the phase of the day. The phases considered for the proposed system are morning, afternoon, evening, night. Based on the emotion/activity and time of the day system decides genres that are suitable for the current situation. Then, the system recommends songs by considering both the decided genres and the information in the user's profile. Fig. 6 shows the entire architecture of the proposed system.

6.3 Emotion Detection

The system first captures the image of the user's face by using the device's camera. Before starting the camera, it takes permission from the user to get access to the camera. The captured image acts as input for the emotion detection module. From the input image, the emotion of the user gets detected. To detect facial emotion from the image, facial-emotion-recognition package [10] is used in the proposed song recommendation system. It detects the face in the given image and creates a bounding box around the face of the person present in that image as seen in Fig. 7. At the top of the bounding box, it puts text representing the recognized emotion.

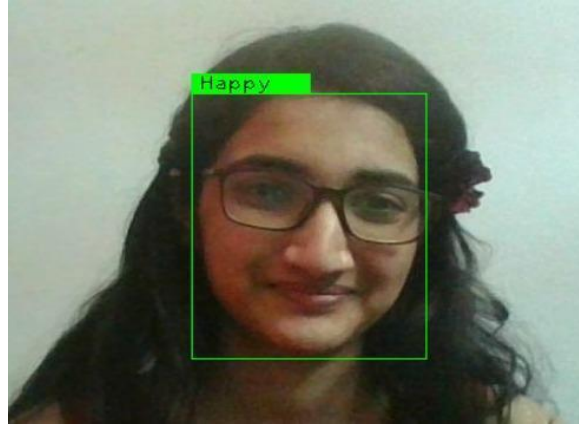


Fig. 7. Sample Input Image for Emotion Detection

6.4 Algorithm to Detect Genre for the Songs based on Activity or Emotion

This section provides a mathematical model to detect the specific genre. It considers six factors - emotion, genres, era, singer, time of the day, activity. Using these factors, the genre preferences have been set and are stated in section 6.1. Each of the six genres is coded with a unique number as shown in Table 6.

Table 6. Code Numbers given to Different Genres

Code Number	Medium
1	Dance
2	Rap/Hip-hop
3	Soul/Funk
4	Pop
5	Jazz
6	Classical

After detecting emotion or taking activity input from the user, the system creates a list of preferences for a particular emotion or activity as stated in Table 2 (for emotions) and / or Table 5 (for activities). For simplification, let's say this list as list_1. In the next step, the system selects the phase of the day considering the time. And it creates another list of genre preferences considering the time of the day using Table 4. Let's say this is list_2. The user preferred genres are taken as the primary choice and remaining will be secondary choices. Those genres which are not present in the user's profile are removed from lists i.e. list_1 and list_2. The sequence of the lists will not be disturbed while removing the secondary genres. The average of code number of the first genre in list_1 and in list_2 is calculated. The float average is converted into integer using floor function. This integer average is treated again as a code number. The system takes the genre corresponding to the integer average using Table 6. This yielded genre does not ensure

that it will be in primary choices. So, the genre is redirected to further steps. The system selects the type of bass of selected genre using Table 3. Preference list for the selected bass, taken from Table 1, is considered as the final preference list. Again from the final preference list, the genres not present in the user profile get removed. Finally, the top two genres of this final preference list are selected for the filtration process as described in the next section.

6.5 Filtration of Songs for Dynamic Preferences

Dynamic Preferences are those which are inputted by the user. Here, the era, genre and singer(s) are dynamic preferences. As shown in Fig. 8, a filtration of songs for recommendation starts from era. The system first filters songs according to eras stored in the user profile. Applying the algorithm, described in section 6.4, two genres are selected. Then, the songs are filtered from the dataset in order with era and genres. This list is once more sorted to such an extent that the user preferred singers are given the highest priority. Here, the user preferred singer is considered a primary choice. Thus, the final list of songs considering the singers is ranked in order of user preferred singer and other singer.

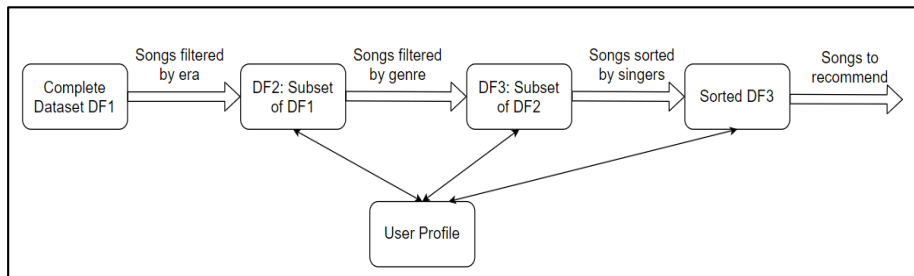


Fig. 8. Songs Filtration Process based on Era, Genre and Singer

6.6 Results

The mood-based song recommendation system is designed in accordance with the results of the user survey. The distinctive feature of this system is that it recommends songs based on the factors such as singer, genre, era, activity, and time of the day. Content-based filtering is performed on these factors to suggest songs to users. The majority of the song recommendation system does not account for the activity and time of day while recommending songs to users. For this reason, other song recommendation systems are loosely linked to the emotions and preferences of the user. While the proposed system analyses the current status of users and feelings for recommending songs which makes it more interactive. The user search time can be reduced by recommending songs according to the actual emotional state of the user.

7 Web Application

An interactive and responsive web User Interface (UI) for the proposed system has been designed as depicted in Fig. 9, and it is compatible with device of any size. For the development of this UI, several web development tools such as Hypertext Mark-up language (HTML 5), Cascading Style Sheets (CSS), Bootstrap, Visual Studio Code, JavaScript (JS), node.js, Node Package Manage (npm) and ReactJS have been used and it makes the Mood-based Song Recommendation System more interactive.

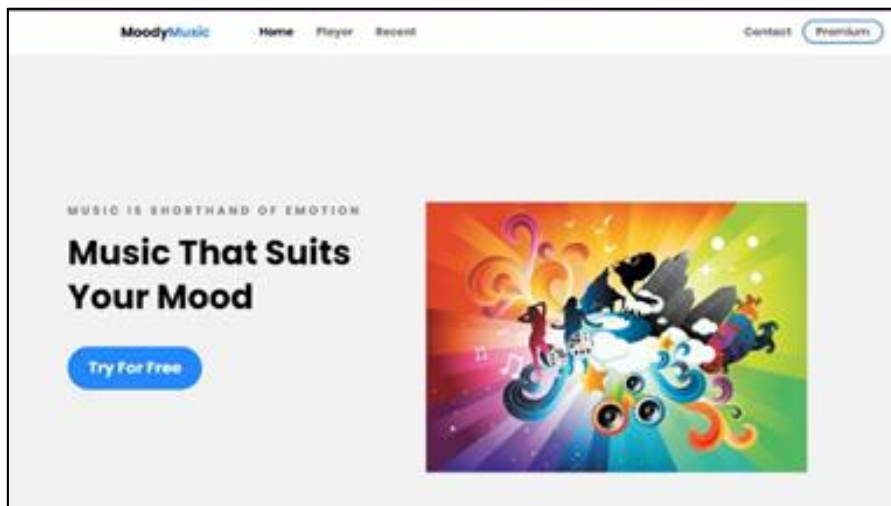


Fig. 9. User Interface of Mood-based Song Recommendation System

7.1 Web UI Development Tools

This section discusses about web development tools used.

HTML5: HTML5 is a mark-up language used for structuring and presenting content on the World Wide Web. It is the fifth and last major HTML version, which is mentioned in World Wide Web Consortium (W3C) as recommendation for front-end. The current specification of HTML is known as the HTML Living Standard. In this web application, it is use for the formatting the text.

CSS: It is the language for describing the presentation of Web pages, including colours, layout, and fonts. It allows one to adapt the presentation to different types of devices, such as large screens, small screens or printers. CSS is independent of HTML and can be used with any eXtended Mark-up Language (XML) - based mark-up language. Most of the web application is developed using HTML and CSS. Here, it is used for styling the web pages.

Bootstrap: Bootstrap is an open and free HTML, CSS and JS toolkit. Using Bootstrap, a responsive website has been developed effectively. Here, it is used for making the web page responsive.

Visual Studio Code: Visual Studio Code is a streamlined code editor with support for development operations like debugging, task running, and version control. All of the source code has been written in Visual Studio Code.

Npm: It is the package manager for the Node JavaScript platform. It has been used to put modules in place, so that node can find them. It manages dependency conflicts intelligently.

React.js: React.js is an open-source JavaScript library. React.js is used for building user interfaces.

Node.js: Node.js is a scalable, light and open language platform which makes building of an app easy even at enterprise level. So, it has played an important role in building our web UI.

Spotify Web API: This Application Programming Interface (API) can simply be used by registration on the web-site of Spotify. It prepares environment for application, and then project or app files and folders can be created.

7.2 Web UI Tabs

Functions of tabs present in the web UI of the Mood-based Song Recommendation System are as follows:

Try for Free: Users can use the Mood-based Song Recommendation System for free. In the free version of the system, users experience limited accuracy of the emotion detection algorithm.

Premium: For more accuracy and efficiency, users have to upgrade the system to the paid version through the premium button. In the paid version (which is not developed in the first phase), the system will use additional technologies in order to accurately detect emotion of the user. These technologies include- emotion recognition from speech and from heartbeats measured using sensors.

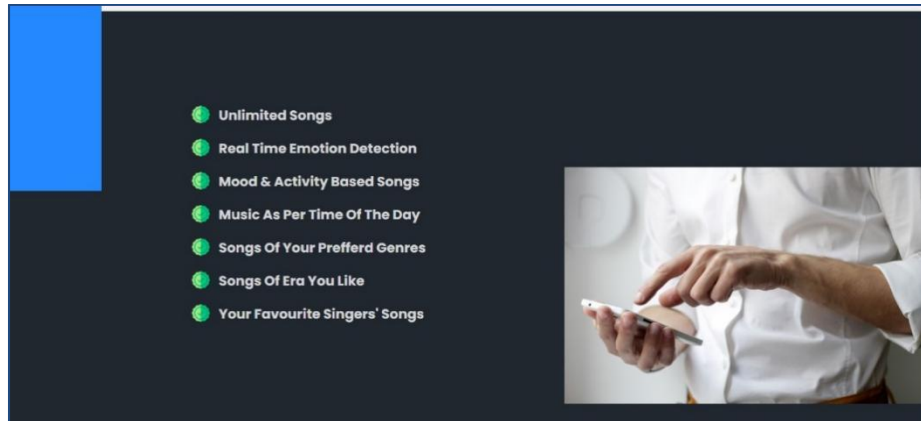


Fig. 10. Feature Section of Home Page in Web Application

Home: The Home tab gives an overview about the system and its unique features as shown in Fig. 10. From the Home tab, users can start their free trials. In the free trial, the system prompts the user to take his picture and detects the emotion of the user in real time. The system then passes these parameters to the Spotify Web API for filtration. Filtered songs are then recommended to the user.

Music Player: A basic music player with a large number of songs from the Spotify database are available to users in this section. The users can search for specific songs and listen to them. Users can create their own playlists just like Spotify.

Recent: In the recent tab, users can see a list of recently played songs.

Contact: This section provides contact information about the authors and managers of this application.

8 Conclusion and Future Work

Songs are getting released and recreated every day, resulting in huge size datasets of songs. The task of maintaining songs, searching songs, creating playlists by processing large numbers of songs is tedious. To reduce time of searching, songs recommendation systems are needful in day-to-day life, to get songs played automatically depending on the emotional state of the user. The mood-based song recommendation system is made for entertainment by interacting with the user. Current music recommendation systems face the gap in personalization and sentiments while suggesting songs to the user. For this research work, a user survey is conducted. The factors that highly influence the selection of songs are evaluated through this user survey. In the proposed system, an algorithm is developed for the song recommendation. The system captures the image of the user and detects emotion from the facial expressions. According to the detected emotion or selected activity and five factors which include - singer, genre, era, activity

and time of the day system recommend songs to the user. The system eases the work of the end-user by capturing the image using a camera, determining their emotion, and suggesting a customized play-list through a more advanced and interactive system.

Human work aspects - emotions and user preferences, as discussed in general HWID framework [8, 19] are considered in recommendation of songs. Few passionate users were involved, and their user experience has been considered in interaction design of this system. The environmental and contextual factor, as per general HWID framework such as time of the day has been vital factor in proposing a recommended song list to the users. Thus, the effect of HWID perspective [8, 19] can be observed prominently in system design of Mood-Based Song Recommendation System.

However, the database used for this research work contains a limited number of songs. So, with this system user do not get access to a large number of songs. The access to the large number of songs can be given by attaching a song library to this system. The dataset for this system consists of Bollywood songs only. This system can be extended for songs in various languages. It can be achieved by appending datasets of songs in various other languages. This system recommends songs using content-based filtering. Its recommendation can be improved by adding collaborative-based filtering. Hence, the system can recommend more appropriate songs using hybrid recommendation techniques.

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