# MUSIC RECOMMENDATION SYSTEM USED EMOTIONS TO TRACK AND CHANGE NEGATIVE USERS' MOOD

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5 authors, including:

Marwa Hussien Mohamed
October 6 University


Mohamed Khafagy
Fayoum University


Mohamed Hasan Ibrahim
Fayoum University


Haitham Rizk Fadallah
October 6 University

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# MUSIC RECOMMENDATION SYSTEM USED EMOTIONS TO TRACK AND CHANGE NEGATIVE USERS' MOOD

[1] MARWA HUSSIEN MOHAMED, [2] MOHAMED HELMY KHAFAGY, [3] MOHAMED HASAN IBRAHIM, [4] KHALED ELMENSHAWY, [5] HAITHAM RIZK FADLALLAH

[1] October 6 University, Department of Information systems, Egypt

[2] Fayoum University, Department of Computer sciences, Egypt

[3] Fayoum University, Department of Information systems, Egypt

[4,5] October 6 University, Department of Information systems, Egypt

E-mail: [1]eng_maroo1@yahoo.com , [1] marwa.hussien.csis@o6u.edu.eg , [2] mhk00@fayoum.edu.eg ,
[3] Mhi11@fayoum.edu.eg , [4] Kmensh.csis@o6u.edu.eg , [5] Haitham.rizk.csis@o6u.edu.eg

**ABSTRACT**

Recently, the Recommender system is the most important research area with the advent of e-commerce and e-business on the web. Emotion-based music recovery will have extraordinary potential in catering nowadays, digital music archives quickly extending in the developing smartphones and ubiquitous environments. Many types of research are conducted to improve the music recommendation to users based on their emotions. Human emotions have much difficulty due to the subjective perception of emotions and accuracy challenges. In this paper, we need to solve the problem of recommending songs to the user based on his selection if it was bad, sad, or angry mood by using our system we will recommend to the user songs from pleasant mood to try changing him to the good mood and track if user listen to this song or scaped it. Our new algorithm, "Hybrid emotion-based music recommendation system," will recommend music to the next level, generating playlist which suits and matches your mood of listening to music. The user can try three choices to get the emotion by using face recognition, choosing three colors, and using the arousal map to select the emotion will appear to users then recommended songs according to his status we merge the output of the system to detect the right mood. Our new system has good novelty and diversity of songs recommended to users and changes the user's mood to the pleasure. At our experimental results We are using precision, recall and f-measure accuracy equations to calculate the effective of our system. To gain high results we apply different experiments detect users' emotions like using face only, colors, arousal map then let users select to types of emotion like face and colors or colors and arousal and finally apply hybrid emotions system. Every time we measure the accuracy of the results. Based on the experiments results using our new hybrid emotions model is best accuracy in surprised, anger, natural and relaxed. While user's emotion sadness using face. arousal map has high accuracy with happy emotions.

**Keywords:** *Recommender System; Emotions; Face Recognition; Content-Based Filtering; Collaborative Filtering.*

## 1. INTRODUCTION

Today's music classification, according to the users' emotions, gains high importance and popularity, throw retrieving information about music. Recommend music merged by emotions are highly preferred to users today and not using searches by title, genre, or artist due to the growing of using the internet and smartphones [1].

There is a lot of research that helps to improve music recommendation according to emotion but has accuracy challenges and difficult to detect the real user emotion. Most of them try to gain accurate recommendations to

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users to help them buy products, listen to music, or to watch movies that they want on this site, but when these algorithms recommend wrong items to users, it will decrease the effectiveness of the recommendations [2].

Human emotions assume an essential part of the relational relationship. The programmed acknowledgment of feeling and emotions has been a research point for the last many years [3,4].

Music psychology research today proves that music induces a clear emotional in its listeners. Musical preferences are highly correlated with moods and personality traits. The music meter, timbre, rhythm, and pitch are managed between areas of the brain with emotions and mood.

There are a lot of external factors that affect music fragmentation like gender, age, living area, education, emotions, and personal preferences. However, a human can select a playlist according to his emotions and categorized it to happy, sad, angry, and natural [5,6].

With the development of digital music, we need to recommend music to users according to his preferences and emotions. There is a lot of work done in this area and build a lot of techniques of recommendation. One is the content-based recommendation used to recommend music to users according to find the similarity between music information like artist name, title, genre. The second collaborative filtering approach is used to find the similarity between rated songs between users and recommend novel items between them [7].

A lot of applications recommend music based on emotion. It includes background music we listen to in the shopping mall to increase sales of products and music therapy [8].

A great many people experience music consistently full of feeling reactions. For instance, happy when tuning in to an incredible execution at a Show or concrete, sadness when tuning in to the music of a late-night movie.

Some researchers have dedicated to understanding the connections between music and feeling from the philosophical, musicological, mental, and anthropological points of view. To help them build a music recommendation system based on emotions with specific rules and matching between musical elements and emotions of users [9].

In this research paper, we talk about recommendation system techniques and do a literature review about the researchers uses emotions with music recommendation. We represent the emotion and its Importance with music recommendation.

We build a new recommendation system, "Hybrid emotion-based music recommendation system" it's contained three ways to detect user's emotions. Firstly, by using webcam face detection, secondly choosing colors with emotions and finally using the arousal map. It's a hierarchically increase in detecting emotion-specific like in the first face detection we have only five moods like happy, neutral, sadness, anger, and surprise, but in colors, we increase the emotion we add love and joy. Our main goal is to track the user status when login to our system his mood is pleasant or unpleasant, so we can recommend several songs to change his mood and track if he listens to these songs or not to change the mood.

The rest of this paper is organized as following a recommender system in section 2, a literature review in section 3, emotion representation in section 4, new algorithms "Hybrid emotion-based music recommendation system," section 5 experimental results, section 6 conclusion, and future work.

## 2. RECOMMENDER SYSTEM

The recommender system is one of the information filtering systems used to predict the rating the user will give to any product according to his preferences. Recommender frameworks have gotten amazingly in ongoing years. It's used to help users to filter through accessible books, articles, web pages, movies, music, restaurants, jokes, grocery products, and so forth to locate the most interesting and significant data for them. Recommender system, it's used by online stores to increase sales for the owners, cross-sell items that are suggested on the checkout page and help users to purchase items more easily and

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increase users' loyalty to make a good deal [10].

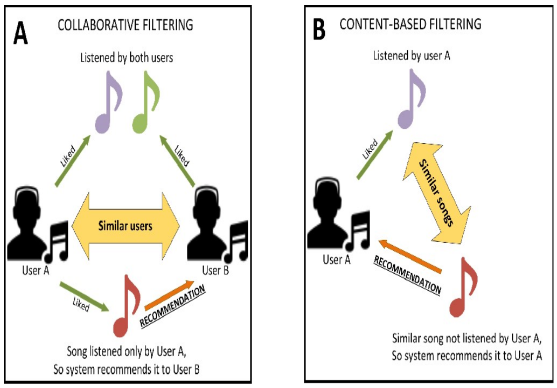


*Figure 1. Content-Based And Collaborative Filtering Algorithms*

Recommender system has three general algorithms: content-based “item-based similarity," collaborative filtering "users-based similarity," and hybrid filter that merge the benefits between the two algorithms" items and users-based similarity." Figure 1 shows the difference between content-based and collaborative filtering algorithms [11].

### 2.1 TASKS OF A RECOMMENDER SYSTEM

We will list tasks a recommender system can assist in implementing [10]:

- Find some good items: A featured list of rated products found that fit the users' necessities.
- Find all good items: A list of items may include users like or interested in finding depending on his history on the recommendation system and the user profile data.
- Annotation in text: A list of items matching the search words using a contextual recommendation system.
- Recommend a sequence: Recommend to the user's items matching the search criteria and some of the items near his interests; maybe he will like this.
- Recommend a bundle: A list of Recommend items are related together or every time users buy this product with another one. Just like buying a camera, you may buy a memory card.
- Just browsing: It's for users using the browser without a specific purpose, the recommendation system must recommend items according to his scope of interest in this session.
- Improve the profile: The system can save the user rating for items as explicit data and preference information.
- Express self: Some users bought a product and didn’t need to rate this product or leave a comment, but it helps the system to find your interests and help others to find the best products according to your comments to increase product sales.
- Influencing others: Certain users may be influential and trying to help another user to buy or not buying the product. Writing a not true comment or review on the product, it's one of the malicious users to the system.

### 2.2 RECOMMENDER SYSTEM BUILDING FOUR STEPS [12] :

1. Data collection:

   Recommendations can be used with any data either personalized like music, movies, books, or non-personalized like magazines, news to recommend a list of ranked or rated items to users.

   We need to build a recommendation list or ranked list by use user preferences as rated items before it's named by explicit data, and we can use user number of rating movies or the number of times listening to a song without rating it can be used like rated items it's named by implicit datasets. The rating of the data can differ from one site to another one. Some websites use rating of items from 1-5 when a user gives 5 to an item, he is highly recommended, and if he gives 1, he has highly disagreed with this item. May other sites using ordinal rating (Strongly agree, agree, neutral, disagree, strongly disagree), binary ratings (e.g.like or dislike, good or bad), etc.

   There are a lot of websites that can help users to try their algorithms using recommendation systems like Movie Lens for rating movies, last Fm for rating songs.

2. Rate prediction

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The rate prediction is used to predict which items we will suggest to users based on his preferences and identify the usefulness of items to him. Also, we used it to compare two or more items we will recommend to this user and rank it with the highest prediction similar ones to his preferences. We use regression, weighted sum, association rule, etc. To make a prediction between items and use Pearson Correlation and cosine vector similarity to compute the similarity between items.

3. Sorting and recommendation of items

   We will make a list of recommended items to the active users sorted by highly predicted similarity and near to interesting items. This list will be sorted in a descending order to find and make a top N predicted items.

4. Performance evaluation of recommender systems

   We can evaluate the recommender system by measuring the overall system goals by measuring the accuracy of the system with precision, recall, and f-measure. Also, we can use the root mean square error. We can divide the data into two groups 80% as a training dataset and 20% as a test data set to evaluate our system.

## 3 LITERATURE REVIEW

Ashu Abdul, Jenhui Chen et [13] proposed an emotion-aware personalized music recommendation system (EPMRS) by combining two approaches the deep convolutional neural networks (DCNN) approach and the weighted feature extraction (WFE) approach to extract the correlation between the user data and the music.

They use a DCNN approach to find the music data features like audio signals and corresponding metadata to be used for the classification processes. Also, the second approach WFE it's used with TF-IDF inverse document frequency to find the implicit rating data from the users to songs they have to listen to.

This proposed algorithm has a better accuracy recommendation system compared with two other systems, content similarity music recommendation systems (CSMRS), as well as the personalized music recommendation system based on electroencephalography feedback (PMRSE).

Gokul Krishnan K, Parthasarathy M, et [2] proposed an algorithm using machine learning to use user emotions as input to the system and build an automated playlist. They built an android application to use the smartphone camera to detect user emotion and recommend songs based on his emotion.

They use machine learning to track which songs the user prefers to listen according to his mood to improve the predicted and next recommended list also, the system track if the user is not enjoying the recommendation list and change these songs.

Vandana Mohan Patil, J. B. Patil, et [12] proposed a new movie recommendation system used ontology to represent domain knowledge integrated with usage data. This algorithm used ontology-based semantic similarity measure. This algorithm gains high accuracy and quality of prediction of the recommendation system.

Kyoungro Yoon, Jong Hyun Lee, et [14] proposed a music emotional recommendation system based on a TV music program's audience rating information. In this program system request from the user to rate the items and select which preferences he needs to listen to on this program based on their emotions. Also, we track the user history search and context information. The experiments prove that building a recommendation system based on selected features from the users, and it's the best one.

Fang-Fei Kuo, Meng-Fen Chiang, et [8] proposed an emotional-based recommendation system based on the association discovery of film music. They modify the affinity graph and the music feature extraction for the association discovery. Their results have an 85% accuracy on average.

Patrick Helmholtz, Michael Meyer et [15] proposes a MOOSIC application that solves the problem of faces users when they need to choose music according to mood and situations by using context information.

They build a lot of playlists suitable to the user's mood and situation, but they don't return to the user to select the music according

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to his mood. This application designed according to emotion-based music recommendation. One of the shortages in this application that miss engages the users to select which songs they need according to mood and situation.

Magha S. Dhavalikar, Dr. R. K. Kulkarni [16] propose a face detection system named by an Automatic Facial Expression Recognition System (AFERS). The AFERS has three steps: (a) face detection, (b) feature extraction, and (c) facial expression recognition.

The first step used to detect the skin color using YCbCr color model lighting compensation for getting uniformity in the face and morphological operations for retaining the required face portion. The second steps get the output of the first step use AAM (active appearance model) to extract the facial features like nose, mouth, and eyes. In the third step, they used Euclidean distance to compare the feature to select which output image expression. They use Artificial Neuro-Fuzzy Inference System (ANFIS) and achieve a recognition rate of around 100% compared to other methods.

Arto Lehtiniemi, Jukka Holm [17] In this research, the authors find the relationship between the context of music recommendation and animated mood pictures. They implement an application with a collection of pictures based on some genres to make a new music recommendation. They engage 40 users to their experiments to try the application and try to see the recommended music according to the pictures they select mood pictures that have good accuracy was up to 85%. Based on their results, 60 % of our users were interested in the music mood application.

Anukriti Dureha [18] propose a new algorithm to use a facial expression of a user to generate a music playlist automatically. This algorithm reduces the overall time and cost taken to build or generate this playlist and increase the accuracy of recommendations based on user dependent and user-independent database.

The accuracy results for joy and surprise mood are 100% and 84.3 %, 80 %, and 66% for sad, anger, and fear, respectively. This algorithm takes around 1.10 Sec to generate a playlist based on facial expression based on a user's mood. The overall algorithm accuracy of an audio emotion recognition algorithm is 98% by comparing the experimental results with other recommendation algorithms.

## 4 EMOTION REPRESENTATION

Everywhere people listen to music, and their mood is affected by the type of song or music they listen to, and physiological reactions affected also. Listening to music motivates tasks like sports and moderating or boosting arousal levels, enhance mood, and used for relaxation. For example, people need to listen to relax and quit music when they are driving in heavy traffic, but they need to listen to loud, energizing music when they are at work. The fist mood the user was in a state of unpleasantly high arousal and, the second mood is a state of pleasantly high arousal [17].

Russell's circumplex model is the most moods and emotions approach used today. Figure 2 shows the Russell model, which maps the y-axis to the activation level and the x-axis to valence. Emotions are placed in such a manner that the alternative emotions (e.g, happy and sad) face each other. In the most effective case, a mood-based music player would contain emotions/moods from every part of Russell's model. iTunes is one of the moodiest playlist generators. It has tagged two axes, where the y-axis represents sad and x-axis happiness.

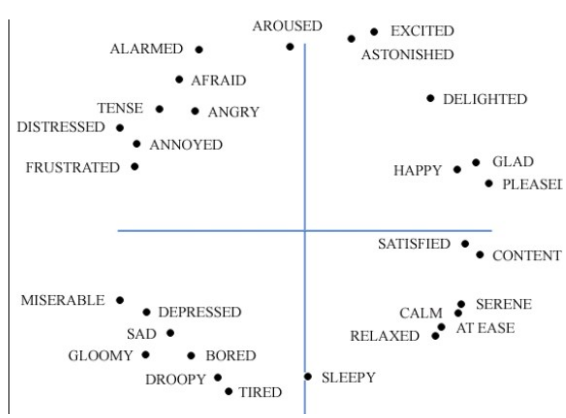


*Figure 2. Russell's Circumplex Model Of Emotions [17]*

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As a default, the axes are color-coded such away that pink represent intense and sad music the yellow intense and happy song the blue color calm and sad music the green color happy but calm music. Once the library has been tagged, the user is capable of outline building new playlists primarily according to his & her current mood with the aid of clicking on the corresponding part of the screen [19].

Emotions play an important role while the user interacts with a recommendation system in different stages. User interaction with the recommendation system and emotions can be divided into different stages from the start point is the emotion the user enters into the system; it's the entry-stage, then the consumption stage, finally, the exit mood stage.

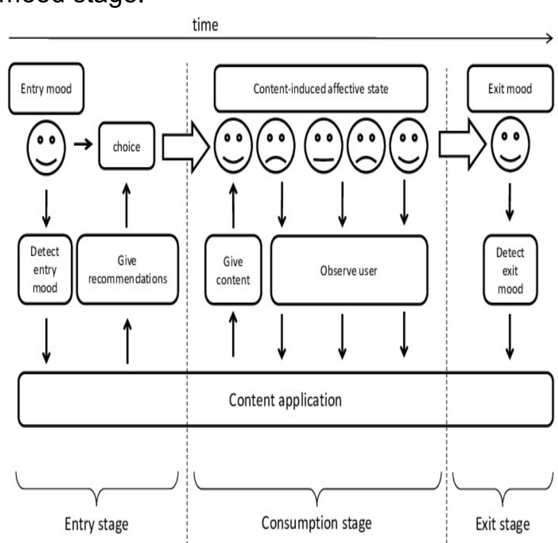


*Figure 3. The Role Of Emotions User Interaction With A Recommender System[19].*

## 4.1 RECOMMENDATION SYSTEMS WITH USER INTERACTION BASED ON EMOTION STEPS

1. The entry mood stage.

   It starts when the users use the recommendation system at first-time system recommends some items to the user based on his choice the system detects the user's mood and choices to build the next recommendation list according to his different moods ad choices from the system. Also, the system uses the user searches as contextual information for the recommendation.

2. The consumption stages.

   This stage has the previous history of the user's choices in the system and matching between his choices and mood. The responses from the recommendation system (i) single values (e.g., The emotional response to listening to music) or (ii) a vector of emotions that change over time (e.g., While watching a movie repeated or a sequence of images).

3. The exit mood stage.

   According to the previous step, the system has a list that will be recommended to the user while changing with the mood. But, in the exit stage, the system must detect the user's mood while leaving the system by tracking the users' behavior, according to the list he sees and tries to save feedback about the system to help users use the system again.

## 5 HYBRID EMOTION-BASED MUSIC RECOMMENDATION SYSTEM

The recommender system describes the importance of personalization. The customer needs to find characteristics of the preferable song on the system.

In our work, we build a new hybrid emotion-based music recommendation system that merges between three systems to detect the users' emotional status and needs to change his mood to neutral or happy if he selects one of negative or displeasure mood.

Why did we need to use emotion with our recommendation system? Because emotion plays an important role in selecting the preferred songs to the user also affects user mood, behaviors, and influence interactions. Emotions are a state usually caused by an event of importance to the subject.

For example, when users are happy, they need to hear all of the things that have good and uplifting energy to them. Also, it makes them want to smile and dance. When users are in an angry mood, they need to hear loud music to get out of the negative energy

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from him. The theme of thong refers to the place, and the situation user songs need to listen like "beach, wedding, driving, party time."

Our new algorithm will use three emotion detection algorithms we named it by hybrid emotion-based music recommendation system because we will let the user try three algorithms in the system to marge between them to detect the exact emotion and mood for the user:

1. Face emotion detection.
2. Emotions based on colors.
3. Emotion using the arousal map.

In our system we need the user select his entry mood and listen to the music and need the users to be in any positive mood so if the user selects an angry or sad mood, we will recommend to him inside his playlist one of the different moods if he like to listen not escape this song we will build and recommend another playlist from the pleasant mood. Also, if he doesn't like the different songs, we will complete in his playlist up to three songs then try to change his mood. The main goal of our system is to make the users in a pleasant mood every time to help users to reduce their negative energy, the pressure of work and life problems to be in full energy and happy on our system mood.

Our system based on this research to make users happy the ones who listened to upbeat and energetic genres were happy after two hours of repeated listening. The reasoning behind this had to do with the link between brain activity and dopamine being released in the rear striatum, the brain's pleasure center ".

Neuroimaging studies [20] have shown that Music has effect on human emotion from sad, nostalgic, and tense to happy, relaxed, calm, and joyous by activating the deep brain area that is part of the limbic system like the amygdala and the hippocampus as well as the pathways that transmit dopamine (for pleasure associated with music-listening).

Our new recommendation system will recommend music based on emotion. We will find the relation between the song's data and genre and emotion. It's observed before by the psychological research. A lot of research needs to find a specific relation between items to hear and emotion. But the best of our knowledge is there are not any psychological rules to match between them. As an example, maybe when users are in a sad emotion, they need to listen to loud music. It depends on the user characteristics, lifestyle, and demographic living area.

In the first step of our system, we need to build user preferences by asking him to answer a questionnaire about his preferred type of music according to his mood. This questionnaire raised to the user up to three times he enters the system only. As an example of a questionnaire is which type of music he needs to listen to when his emotion is happy and suggest some of the singer's names and some of the songs' names. So the system can save some information about this user to build a playlist for him. Also, we will build a static playlist matched with general emotions to the new user will register in our system and discard to answer the questionnaire. Then we will track his behavior on the system and build a user playlist matched with his emotion.

The next step of our system is to select the preferred algorithm need to detect his emotion in the system. We have three algorithms. The first one is the face emotion detection. It has main general emotions like happy, sad, angry, surprised, and sad. The second algorithm is choosing colors to increase more emotions, like when a user selects a yellow color, and he is in one of these moods' good mood, joy, and merry. In the third system, we will let the user detect his emotion from the arousal map; it's more specific to his mood. We merge the output of face detection and color selection to make an accurate mood for the user to make our recommendation.

Our main target to track the users' mood when he was in a negative mood by firstly recommend different song after three songs, he listens in a bad mood then track if he escapes this song recommend another three songs. We recommend a song form a positive mood if he listens, then recommends another song form a positive mood if he escapes the second one. We will recommend two songs from the negative mood then recommend one song from a positive mood. If the user listens to three songs from the

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positive mood. that's what we need to change the user mood to positive or pleasant. Figure 4 shows the track for the user if he listens to the song from different mood or not and reduce the recommendation of songs from negative mood according to the number of songs he listens on the system.

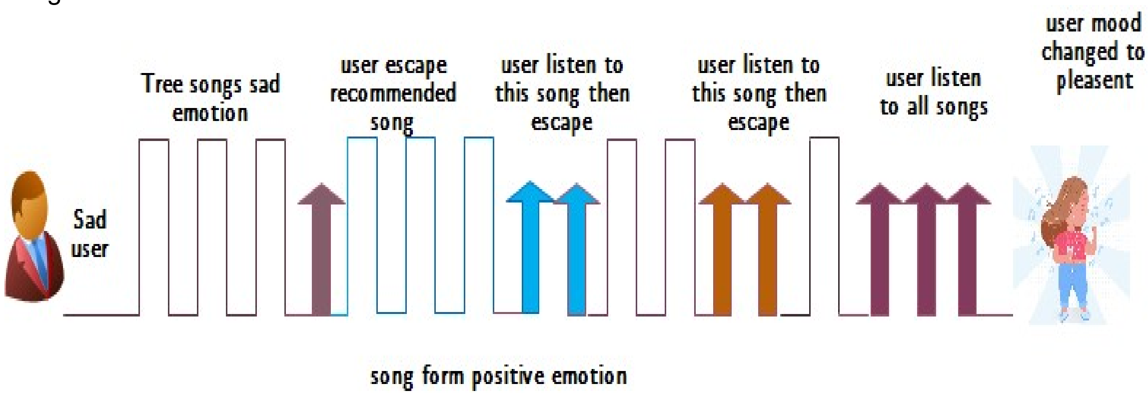


*Figure 4: Shows The Track User Bad Mood To Be Changed Into Positive*

Generally, our new proposed algorithm" hybrid emotion-based music recommendation system " we need the user select his entry mood and try to make the user in a good mood and in a pleasant mood by suggesting a lot of songs from the pleasant mood for the user if he's in an unpleasant mood to change his mood to the best status.

Using our application reduces the manual task of grouping songs in different lists according to emotions, and every user makes his playlist according to his emotion and helps us to use a recommendation system based on users' collaborative filtering to solve novelty and diversity challenges.

Our system has 2 phases:

- Developing a system to detect face emotion figure 5 shows the flow chart for the face detection process.
- Integrate this system with our recommendation system to generate a playlist for users.

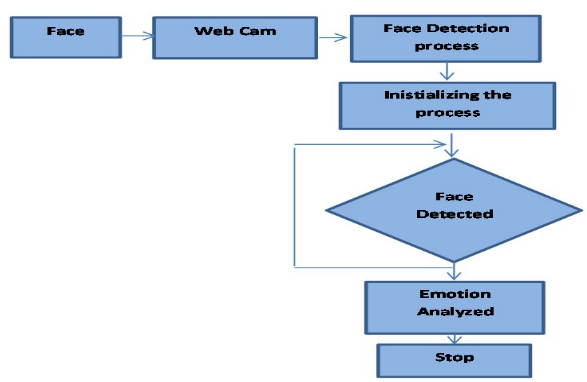


*Figure 5. Flow Chart For A Face Emotion Detection*

Our face emotion system detects the emotions percentage as in figure 6, respectively, neutral was 87%, happiness was 82%, the surprise was 72%, sadness was

## 5.1 FACE EMOTIONS DETECTION

The human face emotion detection has an important role in detecting the user's mood. To do this, we need a system integrated with the camera using the human face as input to the system, then extract information to detect the users' moods according to the face picture taken to the system. We can use the user's mood or emotion to generate a playlist matched with him.

Our new proposed system uses face emotion detection to find the user's mood and use a hybrid recommendation system to generate the recommended list. Using content-based filtering to find the similarity between songs context information and collaborative filtering to find the similarity between users has the same emotion. We request from the user to rate songs after listening. Also, our system detects five emotions like "Neutral, Happy, Surprise" as appositive emotions and "Sad, Angry."

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36%, happiness was 53%, and anger was 72%.

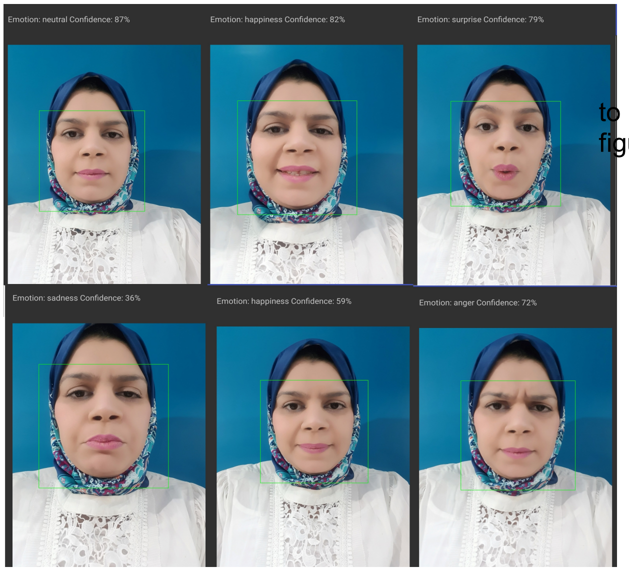


*Figure 6: Shows The Emotion Detected By The Face Recognition System*

## 5.2 EMOTIONS BASED ON COLORS

Your brain is musical; even if you think you might not be in this, we agreed that colors have a strong impact on our emotions and feelings. We need to help users find preferred songs according to his emotions matched by colors.

We build our research based on the research that matches the psychology with emotions and colors [21]. This research matches a lot of colors the user will select with his emotions or status so we can recommend songs according to his preferences. But a lot of research has differently in choosing colors to emotion as an example. Some of the research told if the user selects the red color, he is in a loving mood and happy, but others say that the user in an angry mood.

In our research, we will select more general user emotions like love, happiness, surprise, anger, sadness, and fear. We will match these colors. This method is easy and entertaining for users.

For instance, when users are in love, happiness, surprise, it's in a positive mood, and when users are sad, angry, fear it's in a negative mood. So in our system, we need to enhance the user's mood to the positive status to make him in a good emotion and more energetic.

Here's a list of colors commonly used to identify several emotions and shown in figure 7:

- Red: Anger, embarrassment, passion.
- Blue: pleasure, love, or happiness.
- Yellow, orange: Cowardice, happiness, Surprise, joy, merry, or good mood.
- Green: Disgust, envy, friendliness, happiness, calmness, and feelings of relieving, or greed.
- Purple: Pride, fear, or courageousness.
- Gray: Depression, regular sadness, or stoicism.
- Black: Sadness, fear, Coldness, mournfulness, depression, or loneliness.
- Pink: Cheeriness, embarrassment, happiness, or love.
- White: Shock, love, coldness, or mournfulness.
- Brown: sadness or depression.


*Figure 7 : Colors With Emotions[20].*

## 5.3 EMOTION-BASED ON COLORS METHODOLOGY

In our system, users firstly will make a questionnaire about his favorite songs and singers according to our general list of 6 emotions for the first time the user register to the system. Every time a user login into the system will select three colors so the system can detect his emotions if the colors are from positive emotions, we will recommend songs according to this if the user select two positives

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and one-color negative, we will recommend the positive else the user select two negatives and one positive we will recommend songs from negative emotions.

Our main goal in the system when users are in a negative emotion, we will recommend different songs to change his mood to neutral or happy and track if he listens to this song or not to change his playlist.

Our system is using the content-based recommendation system by recommending the song from the same emotion category and from finding the similarity of context information about the songs. Also, use a collaborative filtering recommendation system by finding the similarity between users to recommend songs, listen by another user in the same emotions and status to make a lot of diversity and novelty songs to the users.

After the song ended, we request from the user of the song to rate to make explicit data sets with sons also rate if the songs were matched with his emotion or not. So we can recommend songs with the best accuracy to the user, and suitable to the emotions.

## 5.4 EMOTION BASED ON COLORS, ARCHITECTURE:

The architecture of hybrid emotion-based music recommendation based on recommending songs based on emotional colors. Firstly, we will detect user emotion be choosing three colors, and the system is a hybrid between two recommendation system techniques content-based and collaborative filtering recommendation system. Here is we will discuss the steps of selecting the emotion end, then generating the recommendation playlist songs to the user. Figure 8 shows the system architecture emotion based on colors.

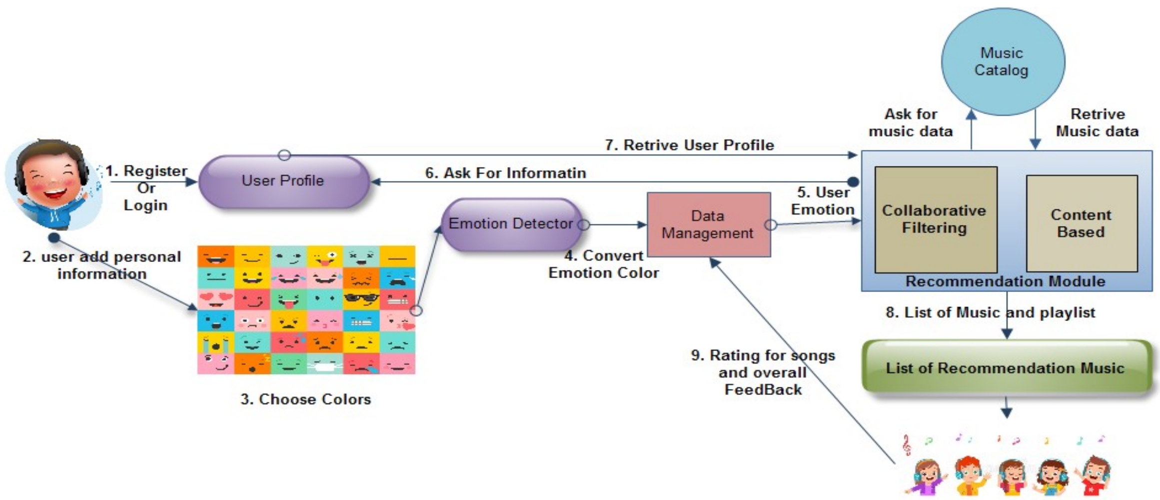


*Figure 8.The System Architecture Emotion Based On Colors.*

Our system architecture is based on five steps:

- User profiles: we will save the users general data like (name, age, living area, password) and registration firstly with answering to the first questionnaire and his searching history on the site and matched songs with emotions selected and then saving the history of the three colors the user choose when login to the system.
- Music information: it contains songs information and related emotions and some of the song features (singer name, year, duration, genre, emotion-related)
- Data management: we interact with the user every time he logs in to the system and saves the matched colors and emotions, and we will track the change in the type of music he listened to . This choice will help us recommend music with high accuracy and novelty.

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- Recommendation module: we use the hybrid recommendation (content-based and collaborative filtering) that merge between finding similarity between songs information and similarity between users listen to songs in the same mood or emotion and rate this song as an explicit data.
- Emotion detector: use to find the emotion of the user if he is in a pleasant or unpleasant mood by choosing three colors and track the change of users' mood in the session to be in a pleasant mood.
- Application interface: we will make our application more easy and friendly to the user.

### 5.5 EMOTION USING THE AROUSAL MAP

Listening to your favorite music can reduce stress and give you more energy since you are using is actively providing your mind with pleasure. In the detecting mood algorithm, we need to let the user select his emotions and mood more specifically or more, especially from the arousal mood map. Arousal map contains a lot of emotions we will let the user specify the preferred emotions from the map by easy this step we show the face emotions with names on the map as in figure 9.

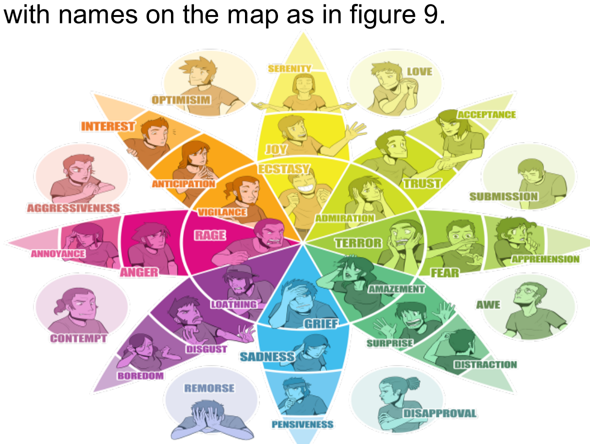


*Figure 9: Arousal Emotion Map*

Our system, after using his mood, we use the hybrid recommendation system (Content-based and collaborative filtering). The main advantage of this algorithm than the others, we build before it has more accuracy for the recommendation.

Also, we ask a user a questionnaire about his first three emotions will select in the system to build his profile information and build a general playlist for every emotion if the user escapes answering the questionnaire.

Our system asks the user to make a rating for songs he listens to the system to make explicit data to increase the accuracy of the system.

Our new system advantage:

- Our system has a good advantage in changing the user's mood to pleasant.
- To provide an interface between the music system.
- To provide very good entertainment for the users.
- To help users detect their emotions in multiple ways.
- To provide new songs easily for music lovers.
- To solve novelty and diversity recommendation challenges in music techniques.

Our new system disadvantage:

- Our algorithm may have a problem with accuracy, while users do not select their exact emotions. So, the system will recommend according to his choice.

## 6 EXPERIMENTAL RESULTS

In this experimental we need to find the accuracy of our third model “new Hybrid emotion recommendation” by using our evaluation methods precision, recall and F-measure to find how is our new system is best accuracy to recommend songs while we engage the emotions to suggest songs to users.

To apply these experiments, we used different types of datasets firstly we need datasets have face for users and detect the users’ emotions, secondly, we need datasets has songs tags with emotions then find the relations between colors and arousal maps to matches with songs emotions and the users detected face emotions.

### 6.1 DATA SETS:

We use DEAM: MediaEval Database for Emotional Analysis in Music [22] it’s a free music data sets collected song ids between 1 and 2058 (these general songs dataset

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collected from LastFm datasets) the number of these songs increased from 744 songs in 2013 up to 2058 at 2015. It has the average of songs rating from 1 to 9.

We use the Cohn-Kanade AU-Coded Facial Expression Database [23]. The database includes approximately 2000 image sequences from over 200 subjects. These datasets have Image sequences from neutral to target display were digitized into 640 by 480- or 490-pixel arrays with 8-bit precision for grayscale values. It has five general emotions Surprise, Happy, Sadness, neutral or relaxed, Anger.

We use the Music–color associations are mediated by emotion datasets the matches colors with emotions [24]. These datasets have 48 participants to find the relations between colors and the songs mood applied via five experiments starts from Music-to-color, Color–emotion, Music–emotion ratings, Music perceptual ratings, Color perceptual ratings. It's built their experiments using 37 colors as in figure 10 that was presented during the music–color association task: red, orange, yellow, chartreuse, green, cyan, blue, and purple at four different lightness-saturation levels (saturated, light, muted, and dark), plus three grays, white, and black.

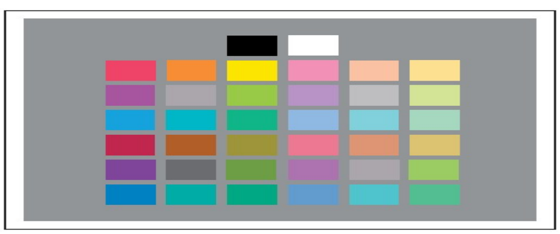

*Figure 10. The Display Of 37 Colors That Was Presented During The Music–Color*

## 6.2 EXPERIMENTAL EVALUATIONS AND RESULTS:

At our Hybrid emotion-based music recommendation system we use the face to detect the user's emotions in our system we use the general face emotions Surprise, Happy, Sadness, neutral or relaxed, Anger. Based on the datasets Cohn-Kanade.

Based on the previous research on music color emotions user select the general colors match with the users emotions but we have 37 colors in the map and we have six face emotions Surprise, Fear, Happy, Sadness, Disgust, Anger from the face emotion datasets. Also, we have arousal map this contain more specific emotions style and user's mood.

When using Hybrid emotion-based music recommendation system with last.fm datasets we find a lot of tags to songs like (rock, mellow pop, American, alternative, folk, indie , blues ,love) and a lot of mood tags ( soft , funk , energetic ,surprise, fun , groovy, happy ,sad). Like the clusters data in table 1.

*Table 1: Datasets In Five Classes Clusters*

| Happy | Anger | Sadness | Neutral relaxed | surprised |
|---|---|---|---|---|
| **happiness** | aggressive | bittersweet | tender | Very surprised |
| **joyous** | outrageous | bitter | soothing | staggered |
| **bright** | fierce | tragic | peaceful | exciting |
| **cheerful** | anxious | depressing | gentle | astonished |
| **humorous** | rebellious | sadness | soft | shocked |
| **fun** | tense | gloomy | quiet | amazed |

After clustering the data into classes, we need to math these classes with colors based on the research Music–color associations the matching between colors, mood, tags in these figures 7-10 to show the matching between colors and tags in songs.

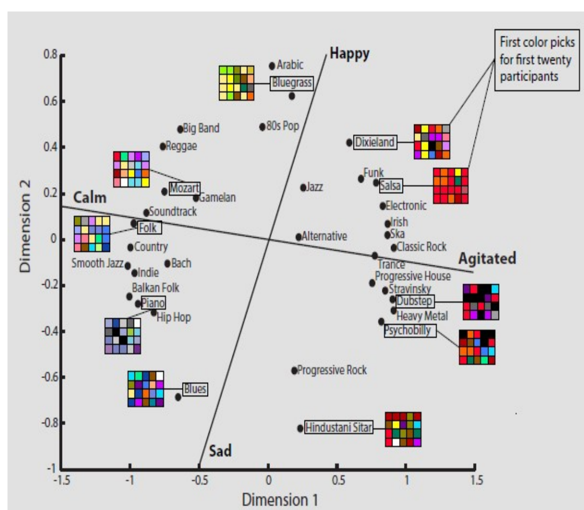


*Figure 11: The Matching Between Tags And Colors*

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The arousal map in figure 7-11 show the mood and places in the map this will match with the figure 7-10 that has colors and songs tags to recommend more specific songs according to users' mood.

## 6.3 FIRST EMOTIONS EXPERIMENT RESULTS:

We run our experiments using evaluation set Mediaeval Database for Emotional it has information's (id, Filename, title, artist, album, genre) and the music color datasets has (mood tag, artists, albums, tracks), (track_id, artist_id, album_id, path,duration,tags).

Firstly, we apply experiments to measure Recommendation accuracy using every emotion (face, Arousal, colors) individual and measure accuracy by f-measure value.

Then we apply our new hybrid model by using the three emotions with the recommendation system. figure 12 show the precision value, figure 13 shows the recall value and figure 14 shows the f-measure value.

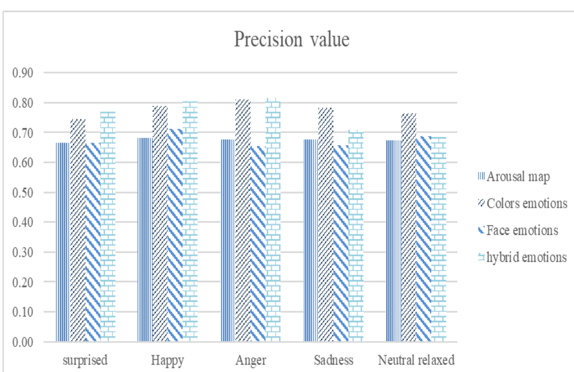


*Figure 12: Precision Value For First Emotions Experiments*

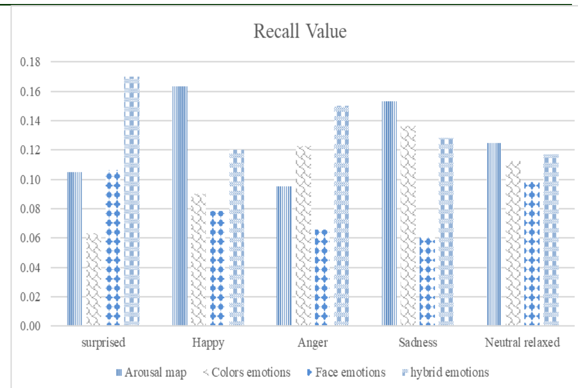


*Figure 13: Recall Value For First Emotions Experiments*

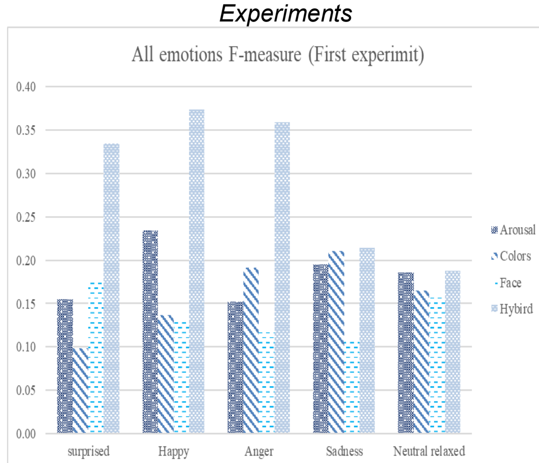


*Figure 14: F-Measure Value For First Emotions Experiments*

Hybrid system is best in accuracy while selecting the positive mood. Hybrid has accuracy by 11 % than arousal ,13% than colors and 15% at face emotion as the value in table 2 for every emotion detected.

*Table 2: F-Measure Value For First Emotions Experiments For Every Individual Emotion*

| Emotions | Arousal | colors | face | hybird |
|---|---|---|---|---|
| **surprised** | 0.15 | 0.10 | 0.17 | 0.33 |
| **Happy** | 0.23 | 0.14 | 0.13 | 0.37 |
| **Anger** | 0.15 | 0.19 | 0.12 | 0.36 |
| **Sadness** | 0.19 | 0.21 | 0.11 | 0.21 |
| **Neutral** | 0.19 | 0.17 | 0.16 | 0.19 |

Accuracy for every emotion (surprise, happy, sad, anger, natural) new hybrid system enhances in surprise mood by 18% than using arousal mood recommendation, by 23% than using colors and by 20% than using face emotions only.

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Happy mood by 14% than using arousal mood recommendation, by 23% than using colors and by 20% than using face emotions only. Anger mood by 21% than using arousal mood recommendation, by 17% than using colors and by 25% than using face emotions only. sadness mood by 2% than using arousal mood recommendation and by 5% than using face emotions only. Neutral mood by 2% than using colors and by 7% than using face emotions only.

### 6.4 SECOND EMOTIONS EXPERIMENT RESULTS:

we apply experiments to recommend songs by based on two emotions selected by users to calculate the accuracy. As we will use arousal map with colors, then arousal map with face and face with colors and recommend songs based on the emotions detected and measure the accuracy f-measure. Figure15 shows precision value, figure 16 shows recall value and figure 17 shows the f-measure value.

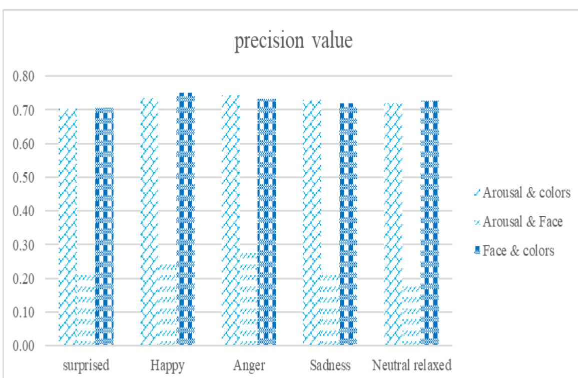


*Figure 15: Precision Value For Second Emotions Experiments*

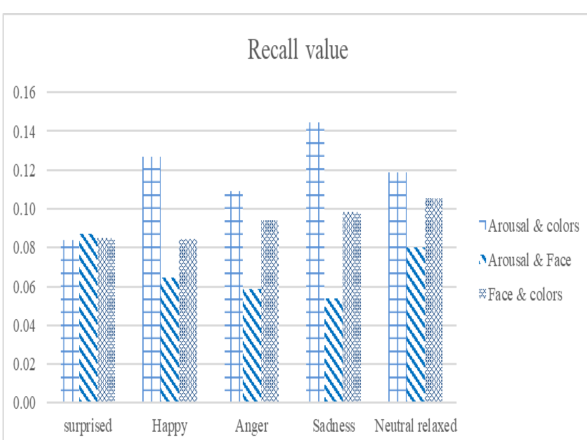


*Figure 16: Recall Value For Second Emotions Experiments*

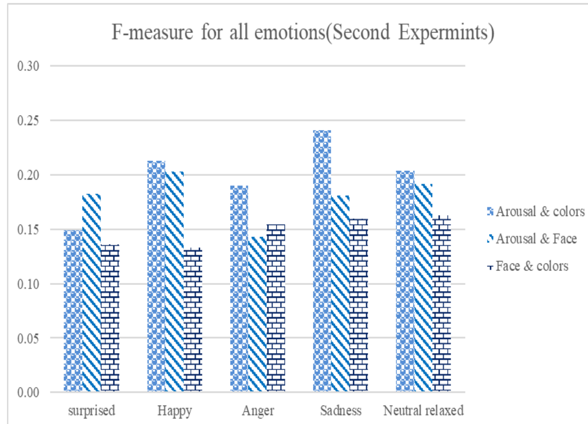


*Figure 17: F-Measure Value*

Based on these experiments merging between Arousal map and colors emotion has best accuracy value with all emotions. but arousal and face have best accuracy in surprised emotions. Table 3 shows the f-measure for every emotion while merging between the emotion's detection system

*Table 3 F-Measure For Second Emotions Experiments For Merging Between Two Emotions Detect Ion*

| F-measure | Arousal & Colors | Arousal & Face | Face & Colors |
|---|---|---|---|
| **surprised** | 0.15 | 0.18 | 0.14 |
| **Happy** | 0.21 | 0.20 | 0.13 |
| **Anger** | 0.19 | 0.14 | 0.15 |
| **Sadness** | 0.24 | 0.18 | 0.16 |
| **Neutral** | 0.20 | 0.19 | 0.16 |

### 6.5 THIRD EMOTIONS EXPERIMENTS RESULTS:

At this experiment we will use the three emotions as hybrid system, but we will recommend songs using one emotion by 50 % and the two others by 25% and measure the system accuracy of recommendation using f-measure. As we will recommend songs using face emotions by 50% and colors and arousal map by 25%.

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Also, we will apply experiments to recommend songs with equally percentage as 33 % for every emotion's detection.

Based on the experiments applied the system when we recommend songs to users based on equally percent in recommendation system has best accuracy at surprised, anger and natural relaxed. Figure 18 shows precision value, figure 19 shows recall value and figure 20 shows f-measure value.

Using arousal map has best happy emotions and using face emotions has best recommendation at sadness emotions as in table 4 show the f-measure value for recommendation accuracy. Using equally percentage emotions is best in surprised, anger, neutral. Face is best in sadness mood and happy is best in arousal mood.

*Table 4: F-Measure Value For Third Emotions Experiments While Using One Emotion By 50%.*

| F-measures | Face | Arousal | colors | Equally |
|---|---|---|---|---|
| surprised | 0.45 | 0.48 | 0.31 | 0.51 |
| Happy | 0.30 | 0.45 | 0.22 | 0.31 |
| Anger | 0.31 | 0.31 | 0.15 | 0.39 |
| Sadness | 0.36 | 0.23 | 0.28 | 0.33 |
| Neutral relaxed | 0.13 | 0.30 | 0.17 | 0.43 |

we recommend songs to users by find the higher similarity between users based on colors emotions. F-measure value has higher accuracy at surprised mood and sadness mood and next is the happy mood. But the sadness mood is the higher precision values because users mainly know that is black and dark grey relevant to the sad mood. The difference between recall value at surprised and happy mood is high because users may select yellow color and orange for happy and others for surprised.

We recommend songs to users by find the similarity based on face detected emotions and recommend songs to users by finding neighbors users has the same mood and the songs they already rate before in the system. The surprise mood has the higher f- measure. Our new system has a near f-measure value at happy, anger and sadness mood the enhancement range between 1% up to 5% best accuracy. The precision value has lowest value at neutral and relaxed emotions because detecting face in this mood is difficult that may be this user in a less happy or surprised.

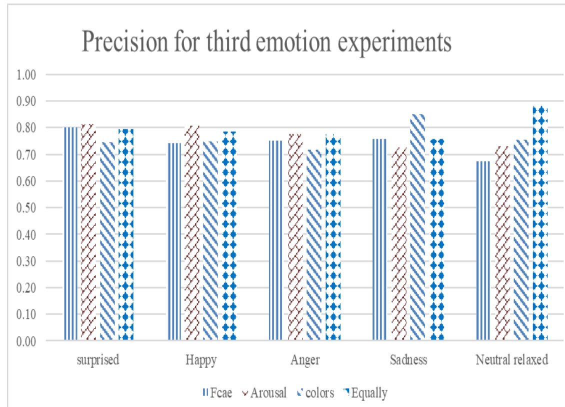


*Figure 18: Precision Value For Third Emotion Experiments*

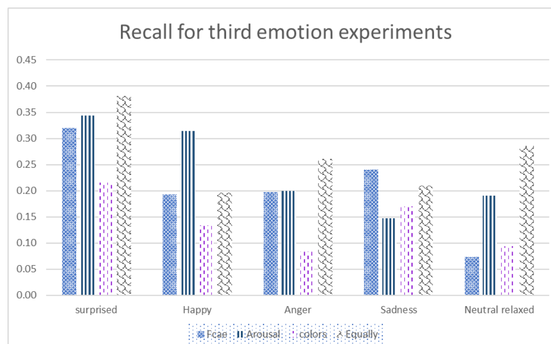


*Figure 19: Recall Value For Third Emotion Experiments*

We recommend songs to users by find the similarity higher between users based on arousal map emotions detected. The f-measure value and precision in these experiments is best accuracy at surprise and happy mood this because users like to listen songs know which track and tags, they need to listen based on this mood and our recommendation system find the similarity between users and solving the recommending issues. Recommending songs with higher similarity using arousal map has higher precision in all emotions selected by users to find his interested songs.

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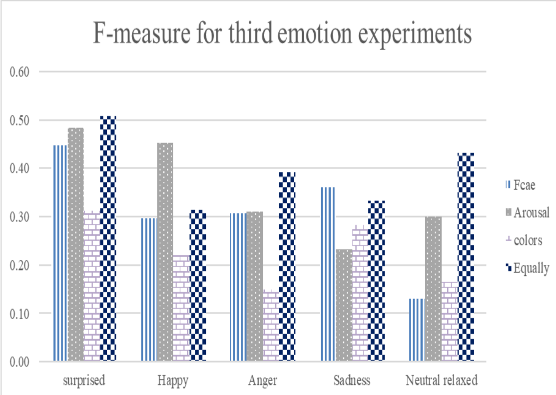


*Figure 20: F-Measure Value For Third Emotion Experiments*

The next figure 21 shows the difference values for emotions while changing in the mood similarity values to find users neighbors and recommending songs accuracy with precision, Recall and f-measure.

At the equally emotion percentage recommendations 33%. We find that the surprised mood has the best accuracy then natural and relaxed mood. The natural mood has higher in precision value that is recommend relevant songs to users based on the selecting emotions.

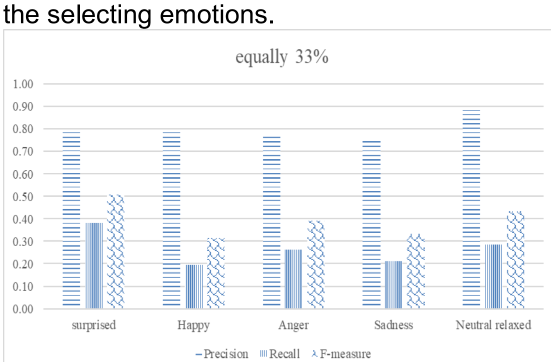


*Figure 21: Accuracy Measure When Emotion Is Hybrid With Same Percentage.*

Finally based on our experiments using hybrid emotions model is best in accuracy while recommending songs as it is good at surprised, anger and natural and relaxed. happy emotions are detected good with face emotions while using 50% of face recommending percentage. happy is best with arousal map. Using arousal map while merging with other emotions is best accuracy in the system than using colors or face.

## 7 CONCLUSION AND FUTURE WORK

Emotions are one of the fascinating features of the human mind. Music is an equally extraordinary characteristic. Understanding the special interaction between the two may take us closer to understanding the fundamental nature of both.

The Recommendation system to music based on emotion is the best choice for an application today for users to gain high novelty and diversity. We build a new hybrid recommendation system based on three systems to detect user emotion by face, choosing colors and, arousal map. Our new system has a good advantage of changes the user's mood to a pleasant or positive mood; it's our main goal.

We apply our hybrid emotions using three emotions face, colors and arousal map using three different datasets include face emotions, colors and music emotions and arousal map and tracks emotions with last FM songs datasets. This model track users while entry mood to the system and try to change his mood from bad mood to positive mood.

We measure f-measure accuracy while using every emotion individual and try to merge two emotions together and finally apply our hybrid model but by recommend songs by 50% on one of emotions and the others by 25%.

Based on the experiments results using our new hybrid emotions model is best accuracy in surprised, anger, natural and relaxed. Our system turn the user’s mood to be happy or neutral than being sad or anger.

This algorithm has high f-measure results compared to the others’ emotions detections system then recommend songs to users not right for his mood.

In future work, building a new emotion-based system give high accuracy at all emotions status while high precision value at happy emotion raised using arousal map only.

we need to build our system with big data number of songs and find more songs matched with the emotions to detect high accuracy [25,26].

Also, we need to make our system more specific to the time users listen to songs just like select if he is travelling or in a vacation or in gym suggest songs based on time and moods. Using spark and Map Reduce [27,28,29] with big data like Last. Fm and

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apply our system with a movie recommendation system. Also, we can use Flink [30,31] techniques to speed the process of finding the best songs to the users rabidly and measure the performance time.

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