CHAPTER I

INTRODUCTION & MOTIVATION

1.1 Background and Motivation

The aim of the project to implement and solve one of the most important problems that no one around notice, music is taking a very huge part of our everyday routine and we choose what to listen to base on many things on them is Emotions. Emotions and music are nearly close in their structure and the way they built with are almost near. In this project is a simple implementation that applies playing music based on any user's Emotion, maybe he/she is happy, sad, nervous, neutral, etc.

This is one of the hardest problem that not many researchers around solved, so this project is a real hard work to solve this problem in a very effective way. In this project studying Emotions in most of the parts, what is Emotions? How it can be constructed? And also how to detect them? Because knowing these things will me it easy develop the app and also help the algorithms know what to learn and why from the beginning. Among the history the constructions of the emotions are very different from history to another and from group of people to another, that's what makes it not easy to solve, and at the beginning it will start be studying very small group of people and expanding to the others by the time.

1.2 Problem Identification

Connecting music and emotion in one single app is not applicable in most areas because of complexity of the project and the implementation, to develop a system that presents a cross-platform music player, which recommends music based on the real-time mood of the user through a web camera using Machine Learning Algorithms.

In this project there is a real time camera app that is capturing an image and then put this for image testing, and after that playing music based on user emotion.

The **Objectives** of this are:

i. To detect face using OpenCV.
ii. To extract and classify emotion using CNN.
iii. To recommend music based on emotion detected.
iv. To helps users automatically play songs based on the emotions.
v. To reduce time and efforts for making manual playlist.

SUMMARY

In this chapter, we have included the overview of our project, problem defination as well as objectives of project. This is one of the hardest problem that not many researchers around solved, so this project is a real hard work to solve this problem in a very effective way. To develop an application which detect an emotion of user and based on that recommend the best fit song to user.

The main purpose of system is recommend music to user through the facial expression detected. To reduced time and efforts for making manual playlist.

CHAPTER II

LITERATURE SURVEY

Sr.no	Title	Author's Name	Summary
1.	Emotion recognition using facial expressions https://www.sciencedirect.com/science/article/pii/S1877050917305264	Paweł Tarnowski, Marcin Kołodziej, Andrzej Majkowski, and Remigiusz J.Rak.	**Objectives:** To recognize seven emotional states: neutral, joy, surprise, anger, sadness, fear and disgust based on facial expressions. **Technology / Algorithm Uses :** For 3D face modeling - Microsoft Kinect , For Classification of features : k -NN classifier and MLP neural networks **Conclusion:** In this experiment, classification of 7 emotional states where achieved with very good accuracy of emotions - 96% for random division of data and satisfactory classification accuracy - 73%, for "natural" division of data. This result was obtained for MLP classifier.
2.	Music Recommend-er System for users used on Emotion Detection Through Facial Features. https://ieeexplore.ieee.org/document/9073556	Ahlam Alrihaili , Alaa Alsaedi ,Kholood Albalawi , Liyakathunisa Syed (Dept.of CS,Taibah University)	**Objectives:** To implement a system that is able to detect user emotions (happy, sad, natural or surprised). Then after the emotion is determined the proposed system will provide the user with a music playlist that contains music clips of certain music types which improve the user's mood. **Technology / Algorithm Uses :** Viola-Jones algorithm (Proposed by Paul Viola and Michael Jones in 2001) , Principal Component Analysis (PCA) method (Proposed by Karl Pearsonin in 1901) **Conclusion:** The proposed system were successfully able to detect user emotions (happy, sad, natural or surprised). Then after system will provide the most suitable music playlist to user which contains music clips of certain music types which improve the user's mood.

3.	Music Recommenda-tion Based on Face Emotion Recognition https://www.researchgate.net/publication/354855186_Music_Recommendation_Based_on_Face_Emotion_Recognition	M. Athavle, D. Mudale, U. Shrivastav and M. Gupta (2021)	**Objective:** The main aim of our proposed system is to provide a music playlist automatically to change the user's moods (happy, sad, natural, or surprised).If person having negative emotion, then a selected playlist is going to enhance the mood of the person positively. To reduce the efforts of users in creating and managing playlists. **Technology / Algorithm Uses :** OpenCV : Haar Cascades / Haar classifier , Haar Wavelet technique ,CNN (Convolution Neural Network) : Activation function - Relu, SoftMax , Loss function - Categorical-crossentropy **Conclusion:** The system help to reduce the efforts of users in creating and managing playlists by facial emotion recognition .There are various aspects of the application that can be modified to produce better results.
4.	Emotion Integrated Music Recommenda-tion System Using Generative Adversarial Networks https://scholar.smu.edu/datasciencereview/vol5/iss3/4	Mrinmoy Bhaumik, Patricia U Attah , Dr. Faizan Javed (SMU , Dallas, TX 75275,USA)	**Objectives :** The main objective is to find out if we can generate a more effective playlist by utilizing emotion as a key feature .To improve the current music recommendation system. **Technology / Algorithm Uses :** Emotion Labeling using Active Learning , Pool-based sampling ,GAN (Generative Adversarial Network), The Cosine Similarity and the Euclidean Distance : to determine the accuracy and statistical significance of the recommendations , Spotify API **Conclusion:** Overall, the results of the research do not point to any definitive conclusion on whether emotion can play a key role in making a better recommendation system. Although there was no statistical significance between the model with or without emotion, the accuracy was better for both metrics in the model with emotion. This study shows that there is potential for emotion to be a significant feature when recommending music.

5.	Mood based Music Recommendation System (06, June-2021)	Ankita Mahadik, Shambhavi Milgir, Vaishali Kavathekar, Janvi Patel	**Objective :** Finding suitable music to be played on detection of fear or disgust mood. **Technology/algorithm used** : Deep Learning based Facial Expression Recognition using Keras. Viola–Jones object detection framework and CNN is used for classification purpose. **Conclusion :** This model, having the accuracy of approximately 75%, is able to detect seven moods accurately: anger, disgust, fear, happy, sad, surprise and neutral; and our android application is able to play the music that would be suitable for the detected user mood.
6.	Emotion-Based Music Player Emotion Detection from Live Camera (June 2019)	Ahmed Hamdy AlDeeb The British University in Egypt	**Objectives:** 1. Build a Face Detection System. 2. Develop Emotion Recognition System. 3. Build an easy to use app using cross-platform open source library "Kivy". **Technology/algorithm used** : Implementing this project is done using Python and Kivy design framework, and CNN. **Conclusion :** The accuracy rate for the app was 85% which somehow good but it needs more training to be more accurate. The app is working properly with almost 90% of the running trials, which is also a good results, but when it comes to detecting the face in real time working also properly and very well.

7.	Emotion based music recommendation system (April 2020)	CH.sadhvika, Gutta.Abigna, P.Srinivas reddy	**Objectives:** In this project chrome as front-End which has the capability to detect emotions i.e, the face of user with the help of machine learning algorithm using python. Based on the detected user's mood song list will be recommend to the user **Technology/algorithm used:** Fisher Face Algorithm used for dimenension reducing the face space. Haarcascade Algorithm for categarize object in an captured image. **Conclusion**. This project is designed for the purpose of making better interaction between the music system and the user.Because music is helpful in changing the mood of the user and and for some people it is a stress reliever.
8.	Music Recommendation System based on facial emotion recongnition (March 2020)	Deny John Samuvel, B. Perumal, Muthukumaran Elangovan	**Objectives:** • To recommended music based on available information such as the album and artist. • Classifying the mood based on pitch and rhythm. **Technology/algorithm used:** Eigenfaces algorithm is used to recognize the face. **Conclusion :** It suggests music by extracting different facial emotion of a person: Happy, anger, surprise, neutral. It is additionally seen that to improve the exactness of the arrangement framework the informational collection used to construct the grouping model could be expanded further.

SUMMARY

After studying the Literature Review, which help us to develop emotion based music recommendation system.In that research paper, recognize seven emotional states: neutral, joy, surprise, anger, sadness, fear and disgust based on facial expressions by using various machine learning algorithms and technologies. i.e CNN,PCA, Fisher Face , Python and Kivy design framework, OpenCV : Haar Cascades / Haar classifier etc.

Then after the emotion is determined the proposed system will provide the user with a music playlist that contains music clips of certain music types which improve the user's mood.

CHAPTER III

PROPOSED SYSTEM AND REQUIREMENT SPECIFICATION

3.1 Proposed Solution/ System & Methodology

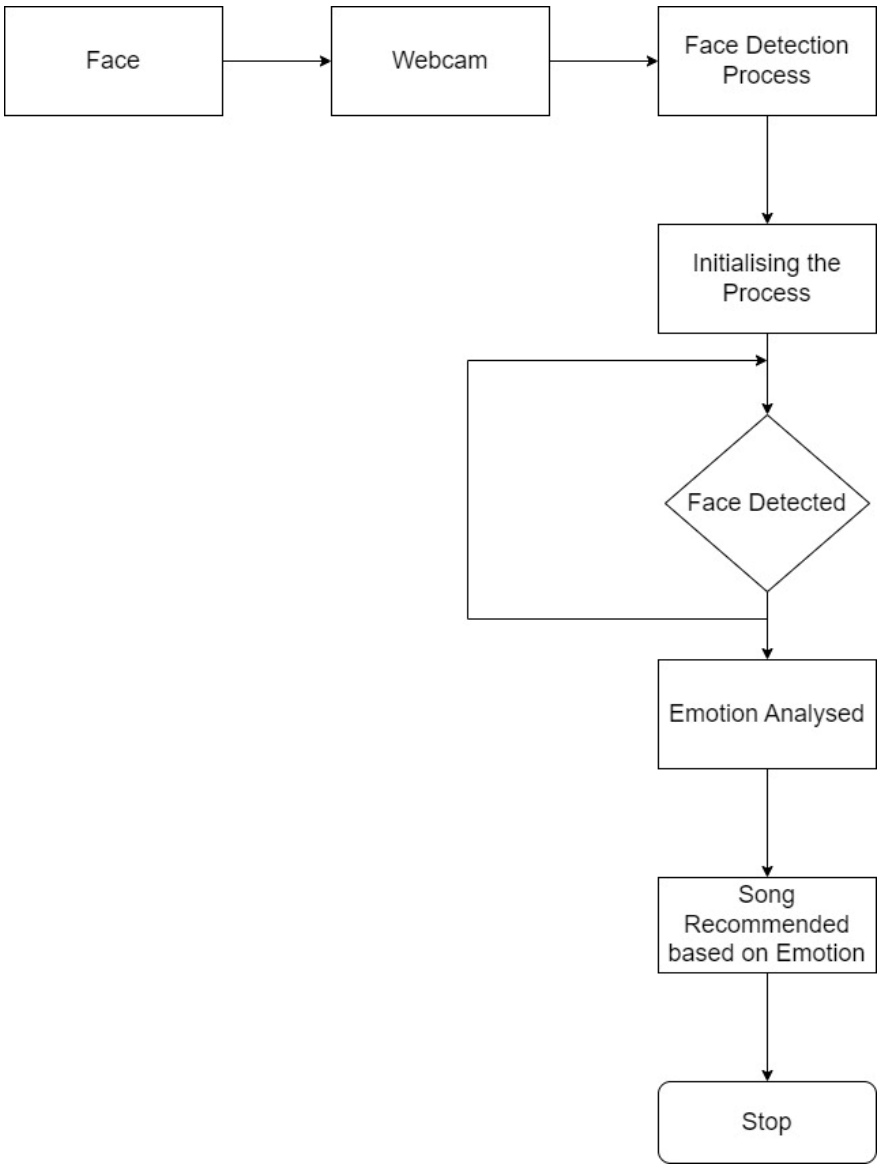

Fig.1. Process Flow Diagram

3.1.1 Face Detection :

Face detection is one of the applications which is considered under computer vision technology. This is the process in which algorithms are developed and trained to properly locate faces or objects in object detection or related system in images. This detection can be real-time from a video frame or images. Face detection uses such classifiers, which are algorithms that detect what's either a face (1) or not a face (0) in an image. Classifiers are trained to detect faces using numbers of images to get more accuracy. OpenCV uses two sorts of classifiers, LBP (Local Binary Pattern) and Haar Cascades. A Haar classifier is used for face detection where the classifier is trained with pre-defined varying face data which enables it to detect different faces accurately.The main aim of face detection is to spot the face within the frame by reducing external noises and other factors. It is a machine learning-based approach where the cascade function is trained with a group of input files.

3.1.2 Emotion Classification :

The image of the user is captured with the help of a camera/webcam. Once the picture captured, the frame of the captured image from webcam feed is converted to a grayscale image to improve the performance of the classifier, which is used to identify the face present in the picture. Once the conversion is complete, the image is sent to the classifier algorithm which, with the help of feature extraction techniques can extract the face from the frame of the web camera feed. From the extracted face, individual features are obtained and are sent to the trained network to detect the emotion expressed by the user.

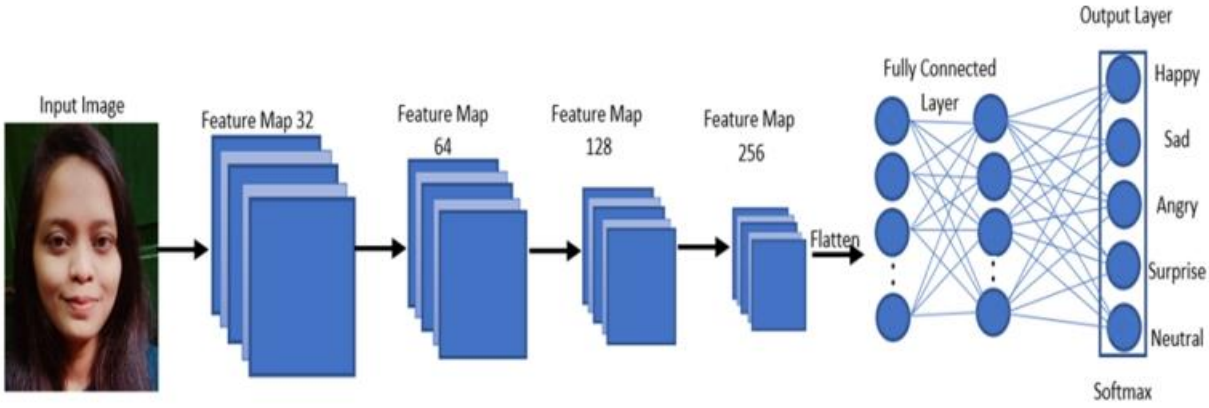

Fig 2.Convolutional Neural network

3.1.3 Music Recommendation

The input images that is acquired is from the web camera and is used to capture real-time images. And here we are four main emotions because it is very hard to define all the emotions and by using limited options it can help the compilation time and the outcome is more sophisticated. it compares the values that are present as a threshold in the code. The values will be transferred to perform the web service. The song's will be played from the detected emotion. The emotions are assigned to every song. When the emotion is transferred the respective song and the emotions are numbered are arranged and assigned to every song.

3.2. Software Requirements Specification-SRS

3.2.1. Functional Requirements

Functional requirement are the functions or features that must be included in any system to satisfy the business needs and be acceptable to the users. Based on this, the functional requirements that the system must require are as follows*:*

- The system should be able to detect the emotion accurately .
- Based on emotion best fit music will be recommended to user.
- The system should have ability to maintain user mood.

System Feature

1) Emotion Detection：

We will detect face of user by using camera then with the help of various library and algorithm we can classify emotion into different categories.

a) Benefit: If accurate emotion is detected then proper song recommended which satisfy user.

b) Priority: High

c) Penalty: If user unsatisfying with the system he/she may change his music recommendation application.

2) Music Recommendation :

We have already segregated music playlist based on different mood. Which will be recommend music to user based on Emotion detected in above step

a) Benefit: If proper song is recommended which will help to change mood of user.

b) Priority:

c) Penalty: If user unsatisfying with the system he/she may change his music recommendation application.

3.2.2 Other Non-functional Requirements

- The system should provide better accuracy.
- The system should have simple interface for users to use.
- To perform efficiently in short amount of time.

1) Performance Requirements

The requirement specification for any system can be broadly stated as given below:

- The system should be able to interface with the existing system.
- The system should be accurate
- The system should be better than the existing system.

2) Safety Requirements

- Sensitive information of user should be kept in safe.
- To prevent unauthorized access of user data.

3) Security Requirements

- The online system will use the security for the system administrator.
- All the details in this system must be secured. It must be confidential.

4) Software Quality Attributes

a) The detail of the user kept secret.

b) No case of fraud is possible.

c) AVAILABILITY: The user need to upload the facial images in the system according to the facial expression the user

d) Emotion will be identified and notified to the client user.

e) CORRECTNESS: The correct Human emotion detected and based on that the perfect song will be recommended.

f) MAINTAINABILITY: The administrators can maintain correct dataset for the user images and the emotions in accordance.

3.3. Significance of the project

1) **Scalability:**

   Quick and cost-effective data processing.

2) **Real-Time Analysis:**

   live face detection and based on that music recommendation.

3) **Business Success:**

   We can identify user emotion so that we can recommend music to user

4) **Consistent Criteria:**

   The music provider can predict and then offer the appropriate songs to their users based on the emotion detected.

Applications :

1) **Entertainment:**

   It provides personalization and thus boosts user engagement. The recommender system is helpful to both service providers and users.

2) **Mood setting:**

   The analysis of the facial expression/user emotion may lead to understanding the current emotional or mental state of the user.Which help to recommend best fit song to user.

3) **Car Driving:**

   Using facial emotion detection smart cars can alert the driver when he is feeling drowsy.

4) **Facial Emotion Detection in Interviews:**

   Recruiter will be able to know, say, the overall confidence level of an interviewee and make a decision about whether or not this candidate will be able to perform well at a client-facing job.

5) **Testing for Video Games:**

   Detecting the facial emotion during playing video game which store as a feedback of user

3.4. Scope of Project

The goal is to design emotion based music recommender system. User's emotional state with facial analysis plays a fundamental part in our project, since it employs non-verbal cues to estimate the user's emotional state. This software system will be able to perform emotion recognition through live camera. With the easy-to-use user-interface of the system. After capturing image system should perform emotion recognition and based on emotion detected our system will recommend the best fit music to user.To reduce the efforts of users in creating and managing playlist.

3.5. Deployment Requirements

1. Hardware:

1) RAM - 8GB
2) Hard Disk - 1 TB
3) CPU - intel core i3
4) Webcam (for testing on laptop/desktop)

2. Software:

1) Operating System: windows 10
2) Web Browser: Google chrome, Microsoft edge
3) Jupyter notebook

3.6. Project Cost Estimate

Task ID	Task	Resource type	Resource cost (Rs)	Hours required	Manpower	Total cost(Rs)	Remark
1	**Requirement Gathering**						
1.1	Documentary Analysis	Analyst	100	100	2	400	
1.2	Planning	Manager	500	300	3	2400	
1.3	S/W Prototyping	Analyst	1000	50	2	2100	
2	**Design**						
2.1	User interface design	Analyst	500	200	1	700	
2.2	Top Down/Bottom up Design	Developer	500	50	2	1100	
3	**Development**						
3.1	Implementation	Developer	1000	500	2	3000	
3.2	Feasibility study	Analyst	500	20	3	1560	
3.3	Project Management	Manager	1500	100	1	1600	
4	**Testing**						
4.1	Test plan	Testing Manager	300	100	3	1200	
4.2	Test case development	Tester	500	150	1	650	
4.3	Test Execution	Tester	500	20	1	520	
5	**Deployment and Maintenance**	Management Staff	1000	10	3	3030	

Total Cost: Rs 18260
Total Hours Required: 1600 hours

SUMMARY

In this chapter, The openCV library used for face detection.It is a process in which algorithms are developed and trained to properly locate faces or objects detection in images. The image of the user is captured with the help of a camera / webcam. CNN algorithm used for classification and extraction of the facial expression. The song's will be played related to the emotion detected.

The emotions are assigned to every song and recommend the playlist to user. we have mentioned Software Requirements Specification which describes about performance, safety and security requirements of our project. The goal is to design emotion based music recommender system.

CHAPTER IV

DESIGN

Architecture Diagram :

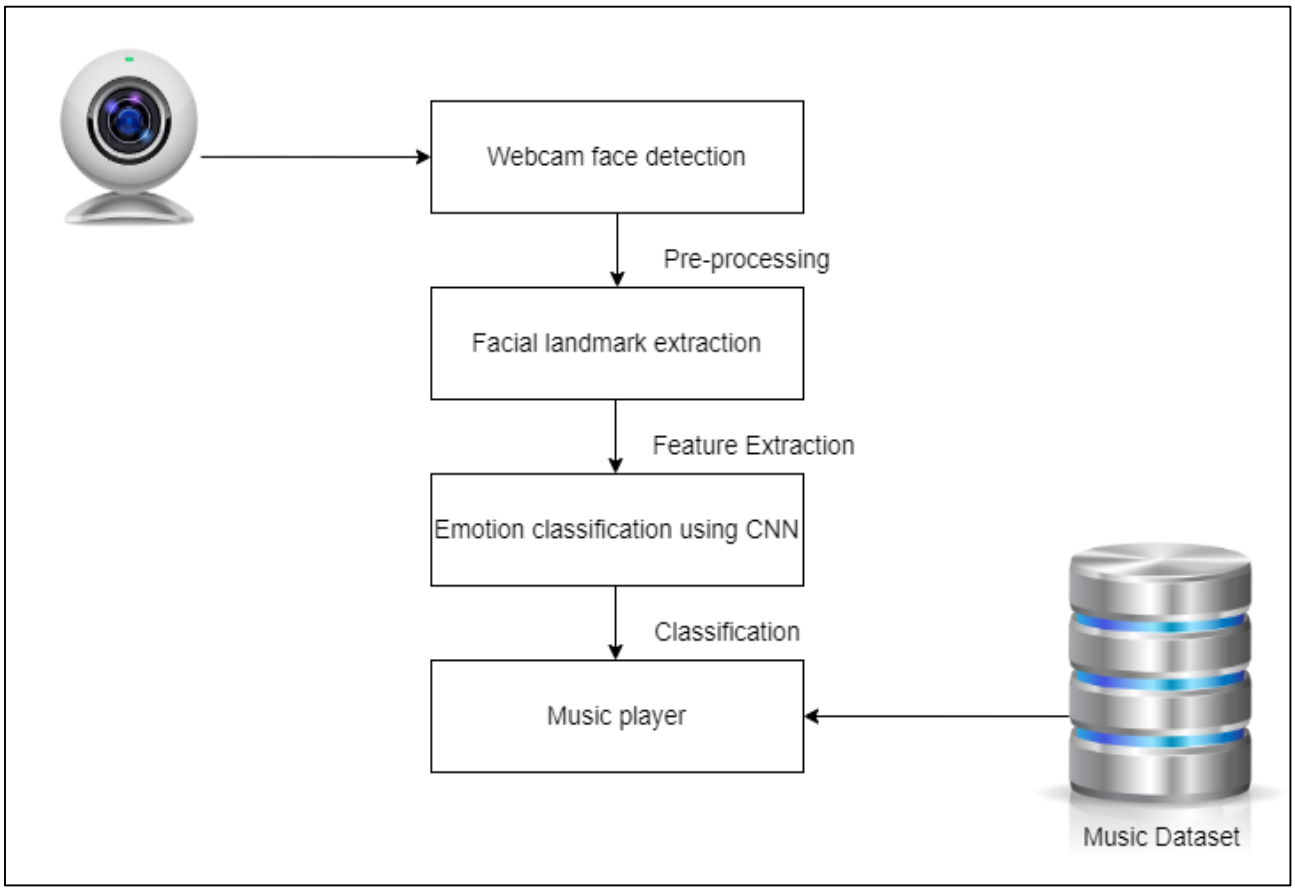

Fig.3.Architecture Diagram

Use case Diagram :

Fig.4. Use case Diagram

Data Flow Diagram :

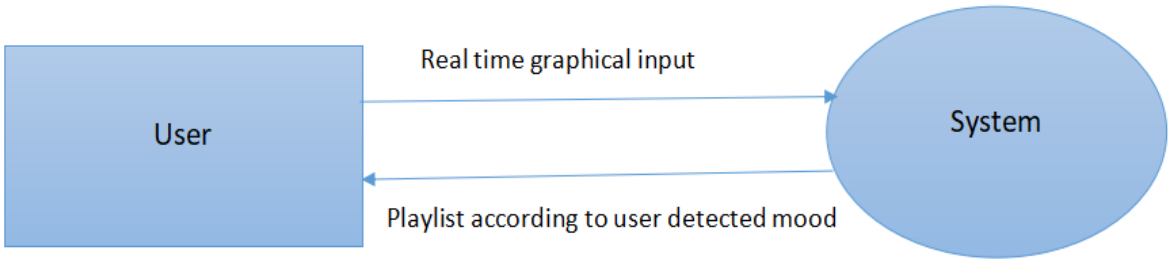

Fig.5. DFD level- 0

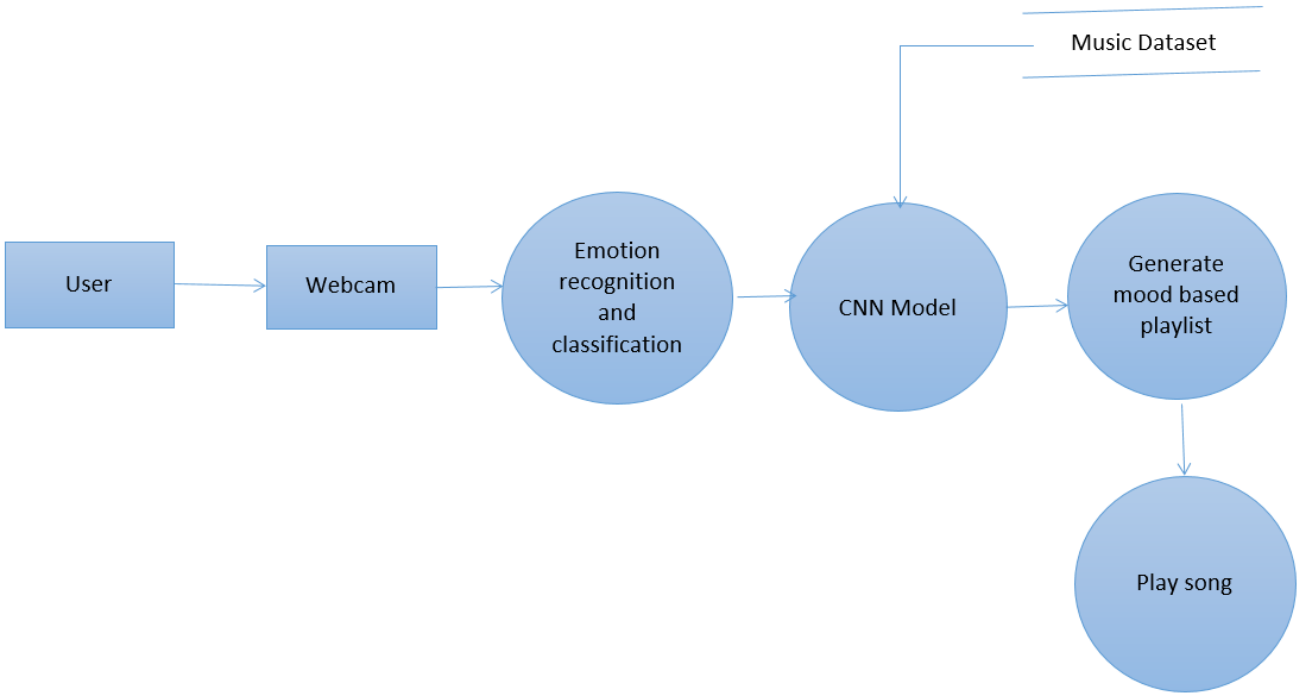

Fig.6. DFD level- 1

SUMMARY

The system architecture diagram is a visual representation of the system architecture. The architecture of a system reflects how the system is used and how it interacts with other systems and the outside world. It shows the connections between the various components of the system and indicates what functions each component performs.

Use case diagram is a list of actions or event steps, typically defining the interactions between a role (known in the Unified Modeling Language as an actor) and a system, to achieve a goal. The actor can be a human, an external system, or time.Another way to look at it is a use case describes a way in which a real-world actor interacts with the system. A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. It shows how data enters and leaves the system, what changes the information, and where data is stored. The objective of a DFD is to show the scope and boundaries of a system as a whole.

CHAPTER V
DEVELOPMENT/IMPLEMENTATION DETAILS

1. Software:

1) Python 3.6:

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. Python is a computer programming language often used to build websites and software, automate tasks, and conduct data analysis. Since it's relatively easy to learn, Python has been adopted by many non-programmers such as accountants and scientists, for a variety of everyday tasks, like organizing finances.

Various domains where python can be used :

- Data analysis and machine learning
- Web development
- Automation or scripting
- Software testing and prototyping
- Everyday tasks

2) Jupyter Notebook:

Jupyter is open-source software, free for all to users. It is a server-client application that allows editing and running notebook documents via a web browser. It is used to develop projects on data science.

2. Libraries:

1) OpenCV 3.1:

OpenCV is a great tool for image processing and performing computer vision tasks.It is an open-source library that can be used to perform tasks like face detection, objection tracking, landmark detection, and much more.

2) Tensorflow:

TensorFlow is a software tool of Deep Learning. It is an artificial intelligence library that allows developers to create largescale multi-layered neural networks. It is used in Classification, Recognition, Perception, Discovering, Prediction, and Creation, etc

3) Keras:

Keras is a powerful and easy-to-use free open source Python library for developing and evaluating deep learning models. It is part of the TensorFlow library and allows you to define and train neural network models in just a few lines of code.

4) Pandas:

Pandas is a Python library used for working with data sets.It has functions for analyzing, cleaning, exploring, and manipulating data.The name "Pandas" has a reference to both "Panel Data", and "Python Data Analysis" and was created by Wes McKinney in 2008. Pandas allows us to analyze big data and make conclusions based on statistical theories.Pandas can clean messy data sets, and make them readable and relevant.Relevant data is very important in data science.

3. Framework:

Flask:

Flask is a backend framework that is used to build web applications. It provides a structure for developers to follow while creating a web app. There is a built-in development server and a fast debugger provided.

4. Technologies:

1) Machine Learning:

A subset of artificial intelligence (AI), machine learning (ML) is the area of computational science that focuses on analyzing and interpreting patterns and structures in data to enable learning, reasoning, and decision making outside of human interaction. Machine learning is made up of three parts:

- The computational algorithm at the core of making determinations.
- Variables and features that make up the decision.
- Base knowledge for which the answer is known that enables (trains) the system to learn.

2) Deep Learning:

Deep learning is a subset of machine learning, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain albeit far from matching its ability allowing it to “learn” from large amounts of data. While a neural network with a single layer can still make approximate predictions, additional hidden layers can help to optimize and refine for accuracy.Deep learning drives many artificial intelligence (AI) applications and services that improve automation, performing analytical and physical tasks without human intervention. Deep learning technology lies behind everyday products and services (such as digital assistants, voice-enabled TV remotes, and credit card fraud detection) as well as emerging technologies (such as self-driving cars).

3) CNN:

Convolutional neural network (CNN), a class of artificial neural networks that has become dominant in various computer vision tasks, is attracting interest across a variety of domains, including radiology. CNN is designed to automatically and adaptively learn spatial hierarchies of features through backpropagation by using multiple building blocks, such as convolution layers, pooling layers, and fully connected layers. This review article offers a perspective on the basic concepts of CNN and its application to various

radiological tasks, and discusses its challenges and future directions in the field of radiology. Two challenges in applying CNN to radiological tasks, small dataset and overfitting, will also be covered in this article, as well as techniques to minimize them. Being familiar with the concepts and advantages, as well as limitations, of CNN is essential to leverage its potential in diagnostic radiology, with the goal of augmenting the performance of radiologists and improving patient care.

4. Languages :

1) Backend- Python
2) Frontend - HTML,CSS , JS

SUMMARY

Jupyter is open-source software which is used for editing and running notebook documents via a web browser. It is used to develop projects on machine learning . Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. OpenCV is a great tool for image processing. TensorFlow is a software tool of Deep Learning. keras train neural network models in just a few lines of code. Pandas is a Python library used for working with data set.

Flask is a backend framework that is used to build web applications. analyzing and interpreting patterns and structures in data to enable learning, reasoning, and decision making outside of human interaction. Deep learning drives many artificial intelligence (AI) applications and services that improve automation, performing analytical and physical tasks without human intervention. CNN is designed to automatically and adaptively learn spatial hierarchies of features through backpropagation by using multiple building blocks, such as convolution layers, pooling layers, and fully connected layers.

CHAPTER VI
RESULTS & DISCUSSION

After detailed analysis of various research papers, For experimental result face detection fisher face,haar casecade,Viola-Jones and for emotion detection SVM,CNN,PCA algorithms are used. In this project Convulutional Neural network is used for emotion classification and feature extraction.

Emotion detection FER2013 Dataset will be used. The data consists of 48x48 pixel grayscale images of faces. To categorize each face based on the emotion shown in the facial expression into one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral). The training set consists of 28,709 examples and the public test set consists of 3,589 examples. Flask framework is used to integrate the machine learning model to web application.For music recommendation manual playlist/spotify API will be used. The system able to recommend music playlist as per user current mood.

CHAPTER VII
CONCLUSION & FUTURE WORK

Conclusion:

In this project music recommendation model is based on users real time emotions that are captured in images. This project is designed for the purpose of making better interaction between the music system and the user. Since music is helpful in changing the mood of the user and for some people it is a stress reliever. Thus , the present system presents Face (expressions) based recognition system so that it could detect the emotions and play the relevant music accordingly .

Future work:

There are various aspects of the application that can be modified to produce better results and a smoother overall experience for the user.The future scope within the system would style a mechanism that might be helpful in Cognitive Behavioural Music Therapy (CBMT) and help the music therapist to treat the patients suffering from mental stress, anxiety, acute depression, and trauma.

SUMMARY

The present system presents Face (expressions) based recognition system so that it could be detect the emotions and music will be played accordingly .

CHAPTER VIII
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