AI Powered Real Time Emotion Detection and Recommendation System

Anita S Patil, Ashish Kumar Jha, Sheetal Janthakal
Abhilash K R, K Sai Sanjana, Ambrin RK
CSE-Artificial Intelligence
Ballari Institute of Technology & Management, Bellary, Karnataka, India
anita.bijapur@gmail.com, jhaashishkumar5432@gmail.com, sjanthakal@gmail.com
kra84195@gmail.com, saisanjanasep2004@gmail.com, ambrinrk04@gmail.com

Abstract: *In the modern digital world, AI and machine learning have changed the way human beings communicate with technology. Emotions are one of the most incredible parts of human communication, and when interpreted by intelligent systems, they can turn digital life into a highly personalized and meaningful experience. The AI-Powered Real-Time Emotion Detection and Recommendation System is a deep learning-based system capable of detecting varied facial expressions, such as happiness, sadness, anger, and surprise from the facial expressions of the user in real time. It will then make recommendations, like music, movies, or places around, according to the detected mood to elevate or sustain the user's mood. Realizing the system through CNNs and their integration with APIs such as Spotify and Google Places led to its accuracy and responsiveness. This project came up not only to help improve emotional conditions but also to bridge the gap between human feelings and intelligent technology in a considerable manner. The solution shows how AI can help in building empathetic systems that understand users and respond thoughtfully to their emotional states.*

Keywords: Emotion detection, deep learning, facial expression recognition, personalized recommendations, real-time analysis, human–computer-interaction

I. INTRODUCTION

AI has become a key enabler in today's digital era for creating emotionally intelligent systems that can understand and respond to human feelings. This project, AI-Powered Real-Time Emotion Detection and Recommendation System, applies the power of ML and DL in building a smart, emotionaware application that can detect human emotions from facial expressions in real time. It applies CNNs for face recognition and emotion classification to recognize feelings of either happiness, sadness, anger, or surprise. After classifying the detected emotion, it gives personalized suggestions for music playlists, movies, or places nearby using APIs like Spotify,

Google Places, and many others. The integration of ML and DL will provide precise emotion detection and intelligent recommendations, making the interaction not only more engaging and adaptive but also more human-like. It aspires to bridge the emotional gap between humans and machines, thereby changing how users experience technology in their everyday lives.

Beyond real-time emotion detection, the system also focuses on delivering a seamless user experience through an intuitive interface. The application continuously captures facial expressions using a live camera feed and processes them with high accuracy, ensuring minimal delay between detection and response. This real-time feedback loop allows users to instantly see how the system interprets their emotional state, making the interaction both engaging and transparent. Additionally, to maintain reliability across different lighting conditions, face positions, and backgrounds, the model is trained on diverse datasets, ensuring consistent performance in real-world environments.

Furthermore, the recommendation engine strengthens the system's usefulness by offering context-aware suggestions tailored to the user's mood. For instance, if the model detects stress or sadness, it may suggest calming music, meditation videos, or peaceful locations nearby. On the other hand, if happiness or excitement is detected, it can recommend upbeat playlists, fun activities, or trending movies. This personalized approach not only enhances user satisfaction but also demonstrates how AI can positively influence emotional wellbeing. Overall, the system moves beyond simple detection and becomes an intelligent companion that adapts to the users' emotional needs.

II. LITERATURE SURVEY

[1] G. K. Sahoo, J. Ponduru, and P. Singh designed a deep learning-based driver facial expression recognition system using the FER2013 database, which might be useful in invehicle applications. They investigated the potential of training a model of deep learning to recognize emotions from facial images to support contemporaneous management of drivers' behavior or state.It focuses on FER, which is the technology that analyzes facial cues to understand a person's emotional state. They used the database known as FER2013, a widely used dataset for facial emotion recognition that contains 35,887 grayscale images of 7 different emotions, namely, anger, disgust, fear, happiness, neutral, sad, and surprise. They employed deep learning models, most likely Convolutional Neural Networks (CNN), to classify facial expressions. After the preprocessing of images, the model will feature extraction with the prediction of an emotion. This was finally intended to be used in real-world applications, particularly in vehicles to record and monitor the driver's emotional state, whether it be for safety purposes or in-vehicle applications.

[2] N. Mehendale (2020) designed a facial emotion recognition system using a two-stage convolutional neural network approach. In the first stage, the model clears the background of the image, such that only the face is analyzed; this helps in reducing a lot of noise and improves the accuracy. Further, an important facial feature is extracted from the second CNN and transforms into a 24-dimensional "expressional vector" to classify the emotion. The system was trained on about ten thousand images and later tested on more than seven lakh images from popular datasets like CK+, Caltech Faces, CMU, and NIST. He reported approximately 96 percent and proved that a four-layer CNN works best for him. On the whole, the paper's contribution is the combination of removing background information with a feature-based CNN, making the model more reliable in real-world applications of emotion detection.

[3] Face detection and alignment in unconstrained environments are challenging due to various poses, illuminations, and occlusions. Recent studies show that deep learning approaches can achieve impressive performance on these two tasks. In this letter, we propose a deep cascaded multitask framework that exploits the inherent correlation between detection and alignment to boost up their performance. Specifically, our framework leverages a cascaded architecture with three stages of carefully designed deep convolutional networks, which predict face and landmark locations in a coarse-to-fine manner. Moreover, we propose a new online hard sample mining strategy that further improves the performance in practice. Our method achieves superior accuracy over state-of-theart techniques on the challenging face detection dataset and benchmark, the WIDER FACE benchmarks for face detection, as well as the annotated facial landmarks in the wild benchmark for face alignment, while keeping real-time performance.

[4] A user's emotion or mood can be detected by his/her facial expressions. These expressions can be derived from the live feed via the system's camera. Lots of research is done in Computer Vision and Machine Learning where machines are trained to identify various human emotions or moods. Different techniques can be provided by Machine Learning in which human emotions can be detected. It may include using the MobileNet model with Keras as it generates a small size trained model and makes the integration of Android and ML easier. Music is a great connector. It unites us across markets, ages, backgrounds, languages, preferences, political leanings, and income levels. Music players and other streaming apps because these apps can be used anytime, anywhere, and can be combined with daily activities, travelling, sports, etc. Along with the rapid development of mobile networks and digital multimedia technologies, the digital music has turned out to be the mainstream consumer content sought after by lots of young people.

[5] This research paper describes a system to enhance the music listening experience by incorporating emotional intelligence into music recommendations. Its main idea is the recommendation of a song by evaluating the current mood of a person through his or her facial expression. The system uses a Convolutional Neural Network (CNN) algorithm to identify the user's emotion from a photo taken via a webcam. The CNN learns to recognize specific patterns in the facial features that connect different emotions. Once the emotion is recognized, then the system recommends a list of songs that are in trend with that kind of mood. This is usually done by diverting the user to some

other website, like YouTube. The goal is to provide a more emotionally engaging, more personalized user experience, making it easier for users to find the perfect song for their moment while creating a relaxing, no-stress environment.

[6] The authors designed a system that looks at a person's face, identifies their mood, and then recommends songs that fit that mood. First, they used a facial-expression recognition model (trained on common emotions like happy, sad, neutral, angry, etc.) to detect the user's emotion via a camera. After the mood is recognized, they connected this output to a music-recommendation module. This module contains different playlists grouped by emotion. Based on the mood detected, the system automatically chooses the matching playlist and suggests songs without having to search manually. In short, they combined computer vision for mood detection with playlist recommendation logic to build an automatic, moodbased music suggestion system.

[7] To build a music recommender that adapts to the user's emotional state, rather than just rely on historical listening patterns. They use a camera to capture the user's facial expression in real time. They extract facial features using a combination of Haar Cascade (a classical computer vision technique) and a CNN for emotion classification. The system classifies expressions into different emotions. Once an emotion is recognized, the system maps that emotion to a "mood category" of songs. Each emotion has a corresponding playlist. According to them, the system reduces manual effort in finding music and can adapt to real-time emotional changes. They probably mention improving the emotion-detection accuracy, expanding the song database, and refining the mapping between emotions and song categories.

[8] There are a number of articles from the year 2023 that discuss recent models that use deep learning for Facial Emotion Recognition, such as models called ResNet, VGG, Inception-V3, and MobileNet. The articles describe a typical process that includes face detection, preprocessing, deep learning for feature extraction, and the classification of the obtained attributes to universal types of emotion. There are a number of research articles that are cited in the earlier articles that used Indian databases or involved researchers from India. The use of Deep learning has been very effective in identifying face emotions, which is a highly essential part of HUMANCOMPUTER INTERACTION.

[9] The aim of the system is to provide music recommendations that are similar to a user's current state of mind, which is a fresh concept different from the existing systems, which are capable of providing music recommendations based on a user's listening history. It uses a deep learning architecture in the form of a Convolutional Neural Network (CNN), which is trained on various datasets such as FER-2013, to interpret the facial expressions that are obtained in real-time from a user's webcam. The deep learning architecture identifies the user's emotions, which are classified into various categories such as happiness, sadness, etc. The system uses the identified emotion to identify a corresponding music category, which recommends a music playlist based on that particular emotion. For instance, "happy" music is suggested when a user is in a "happy" state, while "calming" songs are suggested when a user is "angry." The proposed architecture for the system is time and cost-efficient. The accuracy of performance and computation time, as well as the cost of design, are improved with this result.

[10] For recognizing the emotion, it relies on pretrained models such as ResNet18 and VGG19, coupled with FER2013, to recognize the following emotions: happiness, anger, sadness, surprise, disgust, and neutral. The Support Vector Machine (SVM), as well as Linear Discriminant Analysis (LDA), is used for the classification of musical emotions (such as happiness, sadness, energy, and calmness) from a certain dataset, which is, in this research, from the Spotify database. The pre-defined set of rules connects the recognized facial expression with the corresponding musical mood. This helps in the automated suggestion of a certain Playlist that corresponds with the user's actual current state.

[11] This system applies a real-time face emotion recognition technique to recommend songs corresponding to the current user's emotional state. The system captures a face image from a webcam, which is processed by a deep learning technique, identifying the resulting face emotion with categories such as Happy, Sad, Angry, Neutral, and Fear. This system applies a Convolutional Neural Network (CNN) technique in identifying the user's face emotion, which is commonly trained on a dataset called FER-2013. The resulting face emotion is linked to a corresponding song category, resulting in an automated music list generation corresponding to the user's current face emotional state for improved user experience by providing music that matches the user's current face emotion state.

[12] Face detection is a hot research topic in object detection. For an input image, return the position of the face. To deep learning to perform face detection tasks can be divided into three steps: data input, feature extraction, face feature detection. Feature extraction is the most key part of these three steps. Through the study of the basic principles of the

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current mainstream object detection algorithm, this paper analyzes the characteristics of Two-stage and One-stage detection model, and the application in face detection tasks. Meanwhile, analyze MTCNN in detail, and introduce the specific principle of its implementation. The actual effect of MTCNN in face detection task is verified through experiments, and compared with the results of yolov3 model in the wider face dataset.

[13] A research article published in the International Journal for Research in Applied Science and Engineering Technology, IJRASET, July 2023, describes the Music Recommendation System using Face Expression Emotion Detection. The proposed system detects the face and face features through the Haar-Cascades algorithm and uses a BiLSTM model to provide the appropriate emotion classification. It works with

86.5 percent accuracy in testing by mapping music tracks to target emotions through K-means clustering. Music Recommendation through Face Emotion Detection: The article describes a music recommendation system that suggests music according to the detection of facial emotions of the listener. The authors use the Haar-Cascade face detection method to identify and extract the face from a camera feed and then apply a BiLSTM-based emotion classification model to determine the user's mood with accuracy. On the music side, it employs K-means clustering to group songs based on their emotional characteristics, hence allowing each detected emotion to be matched against an appropriate cluster of tracks. The system automatically recommends songs from the identified music cluster whenever it interprets emotions such as 'happy', 'sad', or 'neutral'. Overall, this study showcases that facial emotion recognition combined with clustering-based playlist mapping could work as an efficient mood-aware music recommendation system.

[14] A deep learning model, most often a Convolutional Neural Network, analyzes a user's facial expression from a camera feed to identify the current emotional state of the user, usually an emotion of one of the universals, such as anger, fear, sadness, happiness, surprise, or neutral. This recognized emotion then acts like a key for retrieval from a pre-defined database or a query upon a music API such as Spotify. The preprint "Music Recommendation System Using Facial Expressions" introduces a system recommending music by first analyzing the facial emotions of a user and then mapping those emotions to suitable music genres or particular songs. At first, the approach uses most often a camera to capture the user's face, where afterward applies a face-detection method such as Haar Cascades or a lightweight CNN, classifying the emotion into categories, respectivelyhappy, sad, angry, or neutral. Once the emotion is recognized, the model maps it to a predefined set of music genres such as: happy → pop, upbeat tracks, sad → soft, slow songs, angry → rock, highenergy music. Then the recommendation engine randomly selects songs from the appropriate category or playlist and presents them to the user. All in all, the preprint emphasizes how simple computer vision can be combined with a simple emotion-to-genre mapping in order to create an intuitive, realtime music recommendation experience.

[15] In the study by A. Tripathi et al., IJETT 2024 presents a song-recommendation system whereby it automatically chooses music according to the detected facial emotions of the user. Therefore, the authors developed a CNN-based model of emotion recognition that would treat live images of a user's face, extracting from them key features to classify the expression into emotions such as happy, sad, neutral, angry, or surprised. Once identified, the system correlates the emotion to a corresponding category of songs stored in a predefined database. Each of these emotions is mapped onto a set of suitable tracks. For example, the happy mood triggers energetic playlists, while sad or calm ones trigger softer selections. The paper explains the full pipeline ranging from image preprocessing, the architecture of CNN, emotion prediction, and the logic applied for relating the emotions to songs. Overall, the system actually shows the integration of deep learning and face analysis to allow for automatic moodaware song recommendation.

TABLE I: COMPARISION OF DIFFERENT APPROACHES

Ref	Year	Approach / Method	Main Contribution	Limitations
[1]	2022	CNN-based FER using FER-2013 for in-vehicle monitoring	Demonstrates real-time FER deployment inside vehicles and validates FER-2013 in practical scenarios	Accuracy drops under low lighting, head movement; limited to car-interior environments
[2]	2020	CNN (FERC) trained on FER datasets	Provides a baseline CNN model for facial emotion classification	Works only on static images; struggles with subtle or overlap-

			with reliable performance	ping expressions
[3]	2016	MTCNN for face detection and alignment	Introduced MTCNN as a robust standard for face localization in FER pipelines	Sensitive to extreme angles and heavy occlusions; does not perform emotion recognition
[5]	2024	CNN-based facial emotion detection + song recommendation	Integrates FER with automatic playlist suggestion, showing end- to-end emotion-aware recommendation	Limited to predefined emotions; real-time performance impacted by lighting and camera quality
[6]	2023	FER + ML-based playlist generation	Enhances recommendation relevance by mapping emotions to personalized playlists	Dataset imbalance; demographic variations affect accuracy
[11]	2025	Real-time FER pipeline with music recommendation	Demonstrates real-time FER + recommendation interaction in a user-facing system	Early-stage research; lacks personalization and large-scale evaluation
[13]	2023	BiLSTM + clustering emotion-to-audio mapping	Introduces advanced sequence modeling for mood-based music recommendation using FER outputs	Requires large audio datasets; higher model complexity with more emotion classes

III. COMPARISON BETWEEN THE EXISTING SYSTEM AND PROPOSED SYSTEM

A. Existing system

In classical existing solutions for emotion detection, most models are dependent on conventional image processing solutions and shallow neural networks. In these models, the prime consideration is given to static images, which lack real-time analysis capabilities. Inaccuracies are generally introduced in the detection process because most models are dependent on carefully designed, manually crafted features such as LBP, HOG, or geometric landmarks. Also, existing solutions lack the incorporation of external recommendation engines. The result is that most solutions are generally limited to the identification of corresponding emotion labels, which lack userspecific feedback. User participation is also minimal because most solutions lack a web-based interface, as well as multiple recommendations such as music, location, and so on.

B. Proposed System

The proposed system brings a deep learning-driven architecture that is capable of real-time facial expression analysis with CNN models FER trained models. The design analyzes video streams or uploaded images with a highly optimized model flow that provides highly accurate predictions of the desired emotions. Along with the detection part, the system also includes a multi-recommendation engine which links the Spotify API with mood-based music recommendation, content filtering for movie recommendations, and Google Places API with activity recommendations. The system includes a modern UI that is built with React + Vite, providing a seamless user experience.

IV. PROPOSED METHODOLOGY

The methodology for the Emotion Detection and Recommendation System focuses on accurately identifying human emotions from facial expressions and providing personalized recommendations based on the detected emotional state. The front-end of the system is developed using React.js, ensuring a responsive and interactive user interface, while Tailwind CSS is used for efficient and consistent styling. The backend is implemented using FastAPI, which handles API requests, model inference, and communication between the frontend and the machine learning model. A Convolutional Neural Network (CNN) is trained on facial expression datasets such as FER2013 to classify emotions including happiness, sadness, anger, fear, surprise, and neutrality. The trained model is integrated into the backend and exposed through secure RESTful APIs, enabling real-time emotion prediction from images or video frames. Based on the predicted emotion, the system fetches relevant recommendations for music, movies, or activities using predefined logic or external APIs. The modular architecture ensures scalability, high performance, and ease of maintenance, while

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secure API handling and efficient data processing enhance system reliability. This methodology provides an intelligent, efficient, and user-friendly solution for emotion-aware recommendation systems with scope for future enhancements.

A. User Interface and System Access

The process begins with the user accessing the Emotion Detection and Recommendation System through a web-based interface. The front-end, developed using React.js and styled with Tailwind CSS, provides an intuitive and responsive environment for users to interact with the system. Users can upload an image or enable camera input to initiate emotion detection.

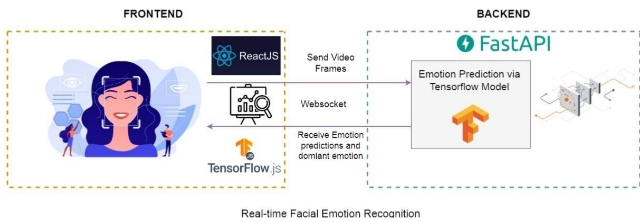

Fig. 1. Implementation Workflow

Once the input is submitted, the system validates the data and prepares it for further processing.

B. System and Model Interaction

After receiving the user input, the system communicates with the backend developed using FastAPI. The backend handles request processing and forwards the image or video frame to the trained Convolutional Neural Network (CNN) model. The CNN analyzes facial features and predicts the user's emotional state. The predicted emotion is then returned to the system for further action. This interaction ensures efficient and accurate emotion recognition.

C. Emotion Classification Process

The CNN model classifies facial expressions into predefined emotion categories such as Happy, Sad, Angry, Fear, Surprise, and Neutral. Image preprocessing techniques such as resizing, normalization, and grayscale conversion are applied to improve prediction accuracy. The classification result is generated in real time, allowing the system to respond instantly to user inputs.

D. Recommendation Generation

Based on the detected emotion, the system triggers the recommendation module. Using predefined logic and integrated APIs, the system suggests appropriate music, movies, or activities tailored to the user's emotional state. The recommendations aim to either enhance positive emotions or uplift negative moods, providing a personalized and emotionally intelligent experience.

E. Result Display and User Feedback

Once the emotion is detected and recommendations are generated, the results are displayed on the user dashboard. The interface shows the identified emotion along with the recommended content in a clear and organized manner.

V. RESULTS AND DISCUSSION

This section presents the results of the proposed Emotion Detection and Recommendation System. The system employs deep learning techniques for face-based emotion recognition from both images and live video feeds. Developed using a TensorFlow–Keras model, a FastAPI backend server, and a React-based frontend interface, the system performs emotion classification and visually displays the results, ensuring smooth real-time interaction and potential integration with mental health support and recommendation services.

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A. Emotion Detection Accuracy and Performance

The system successfully integrates facial detection with emotion classification to ensure reliable, real-time emotion recognition. Key findings are summarized below:

- Strong Emotion Classification: The TensorFlow model accurately identifies multiple emotions including Happy, Sad, Angry, Neutral, Fear, Surprise, and Disgust from diverse user facial expressions.
- Real-Time Detection Efficiency: Using WebSocketbased video stream processing, the system continuously recognizes and updates emotions with minimal latency, ensuring smooth real-time performance on the frontend.
- Noise Suppression via Smoothing: A smoothing algorithm was implemented to reduce jitter and fluctuations in predictions, which significantly improves the stability and reliability of emotion labels during dynamic video feeds.

B. Visualization and Observation

The system provides an interactive and user-friendly graphical interface with the following features:

- Overlay Canvas Display: Bounding boxes along with predicted emotion labels are displayed on detected faces in real time, providing immediate and intuitive feedback to users.
- Upload Functionality: Users can upload images or recorded videos for offline emotion detection. The backend processes the uploaded files and returns emotion labels, supporting asynchronous analysis.
- Frontend Interaction: The frontend, developed using React and Tailwind CSS, ensures a responsive, accessible, and visually appealing interface suitable for users across different devices.

Overall, the system demonstrates efficient emotion recognition performance, robust visualization capabilities, and a seamless user experience suitable for real-time applications.

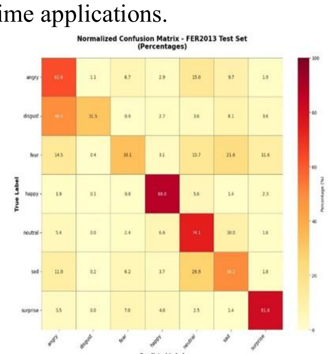

Fig. 2. Confusion Matrix for emotion classification

VI. CONCLUSION AND FUTURE SCOPE

The proposed AI-Powered Real-Time Emotion Detection and Recommendation System uses CNN-based deep learning models, which improve the efficient identification of human emotions while providing personalized content recommendations through integrated APIs. The developed system achieved an accuracy of around 81 percent, hence proving its reliability in real-time applications. It bridges the gaps between human emotions and technology through an interactive interface that enhances user engagement and emotional well-being. The work is a good platform for setting milestones toward emotionaware intelligent systems able to understand human actions and respond with empathy.

Future works can be done on fine-tuning emotion detection using higher models such as CNN-LSTM(Convolution neural networklong short term memory) and transformers. Multimodal input, including speech and text, will improve emotion understanding. Reinforcement learning can develop recommendation precision, while on-device processing and federated learning will provide user data privacy. Extending this system towards mental health support and adaptive emotional analytics will build a higher social and practical impact of the system.

Fig. 3. Per class accuracy of emotion detection model

TABLE II: CLASSIFICATION REPORT OF EMOTION DETECTION MODEL

Emotion	Precision	Recall	F1-Score
Happy	0.875	0.87993	0.87746
Sad	0.56498	0.502	0.53163
Angry	0.5618	0.6263	0.5923
Surprise	0.75166	0.81588	0.78246
Fear	0.58148	0.33105	0.4219
Disgust	0.64815	0.31532	0.42424
Neutral	0.54437	0.74128	0.62775
Average	0.80	0.79	0.79
Accuracy	0.66216	0.66216	0.66216
Macro Average	0.64678	0.60168	0.60825
Weighted Avg.	0.66289	0.66216	0.65343

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