International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 10 | Oct 2025 www.irjet.net p-ISSN: 2395-0072

Smart Emotion-Based Activity Recommendation System Using Convolutional Neural Network

Sindhiya R[1], Akash A[2], Eswar M S[3]

[1]*Assistant Professor, Dept. of Computer Science of Engineering, K.L.N. College of Engineering, Tamil Nadu,*
[2]*Student, Dept. of Computer Science of Engineering, K.L.N. College of Engineering, Tamil Nadu, India*
[3] *Student, Dept. of Computer Science of Engineering, K.L.N. College of Engineering, Tamil Nadu, India*

Abstract - *Facial expressions play a crucial role in non-verbal communication and are an essential component of social interaction. Recognizing emotions through facial expressions has become a significant research area with applications in self-driving cars, entertainment, healthcare, and security systems. Emotion recognition systems (ERS) serve as a vital part of human–machine interaction, enabling computers to understand and respond to human feelings effectively. Recognizing emotions is a challenging task for machines due to variations in facial features, lighting conditions, and individual expressions. To address these challenges, the proposed Smart Emotion-Based Activity Recommendation System Using Convolutional Neural Network (CNN) employs deep learning for precise emotion classification. The system performs four main processes—face detection, preprocessing, feature extraction, and classification. A single CNN model is trained to detect emotions such as happiness, sadness, anger, fear, surprise, and neutral states from real-time camera feeds or uploaded images. Once the emotion is identified, Gemini AI provides personalized activity recommendations such as songs, movies, hobbies, or motivational quotes that align with the detected mood. This integration of CNN-based emotion detection and AI-driven activity suggestion enhances user engagement and promotes emotional well-being. The proposed system demonstrates high accuracy and reliability, making it suitable for real-world applications in mental health support, intelligent user interfaces, and adaptive entertainment systems.*

Key Words: **Emotion Recognition, Convolutional Neural Network, Gemini AI, Activity Recommendation, Real-Time Detection, Mental Health Support, Human-Computer Interaction.**

1.INTRODUCTION

Facial expressions play a crucial role in non-verbal communication and form an important aspect of social interaction. The ability to recognize human emotions through facial cues has become an emerging research area in the field of computer vision and artificial intelligence. Emotion recognition systems (ERS) help machines understand human feelings and react accordingly, enabling a more natural and effective form of Human-Machine Interaction (HMI). Applications of emotion recognition can be found in various domains such as autonomous vehicles, healthcare monitoring, entertainment, education, and security systems.

Emotion recognition through facial expressions is a challenging task because human emotions vary depending on environmental factors, lighting, pose, and cultural differences. Traditional machine learning approaches rely on handcrafted feature extraction techniques, which often limit accuracy and adaptability. With the evolution of deep learning, Convolutional Neural Networks (CNNs) have proven highly effective for image-based emotion classification due to their ability to automatically learn spatial features from facial images.

The proposed Smart Emotion-Based Activity Recommendation System uses a single CNN model for emotion recognition. The system captures facial expressions through a real-time camera feed or uploaded image, preprocesses the data, extracts features, and classifies the emotion into predefined categories such as happiness, sadness, anger, fear, surprise, and neutral. Once the emotion is identified, Gemini AI is used to recommend suitable activities such as songs, movies, hobbies, or motivational quotes to enhance the user's emotional state. The combination of CNN-based emotion recognition and Gemini AI-driven recommendations creates a dynamic and interactive environment that supports mental well-being and personalized engagement. This research aims to contribute to the development of intelligent systems that understand human emotions and respond in a context-aware manner.

1.2 OBJECTIVE AND SCOPE OF THE PROJECT

The main objective of this project is to design and implement a Smart Emotion-Based Activity Recommendation System capable of detecting human emotions in real time and suggesting suitable activities to improve user engagement and mental well-being. The system utilizes a single Convolutional Neural Network (CNN) model for facial emotion recognition using live webcam feeds or uploaded images, accurately classifying emotions such as happiness, sadness, anger, fear, surprise, and neutral. Once the emotion is identified, Gemini AI is integrated to provide personalized

recommendations such as songs, movies, hobbies, or motivational quotes that correspond to the detected emotional state. The scope of this project extends to creating an intelligent and interactive human–computer interface that combines deep learning and generative AI for emotion-aware personalization. The system can be deployed as a web or desktop application and has potential applications in mental health monitoring, entertainment, education, and user experience enhancement. It also provides a foundation for future development in affective computing, where multi-modal emotion recognition and adaptive AI-based recommendation systems can be integrated to build emotionally intelligent digital environments.

2. LITERATURE SURVEY

1.Hybrid Deep Learning Model for Emotion Recognition Using Facial Expressions

Author: Garima Verma, Hemraj Verma – Springer, 2020

Summary: This study proposed a two-stage CNN model for facial emotion recognition. The primary CNN classified emotions into Happy and Sad, and the secondary CNN refined them into Surprise, Neutral, Anger, and Fear. The model was evaluated on FER2013 and JAFFE datasets with preprocessing and dropout regularization.

Merits: Achieved very high accuracy (97.07% on FER2013 and 94.12% on JAFFE), demonstrating the model's strength in distinguishing complex facial expressions.

Demerits: Requires higher computation due to two CNN stages, making it less efficient for lightweight real-time deployment.

2. Activity Recommendation System Based on Facial and Speech Emotion Recognition Using CNN

Author: Rohit Bari, Vaishnavi Belsare et al. – IJSREM, 2022

Summary: The study developed a CNN for facial emotion recognition combined with speech emotion detection. The multimodal approach improves prediction accuracy and is used to recommend real-time activities based on detected emotions.

Merits: Provides richer and more accurate activity suggestions by integrating both facial and speech signals.
Demerits: System performance is sensitive to background noise, reducing accuracy in real-world environments.
3.Emotion-Based Music Recommendation System Using VGG16-CNN Architecture

Author: B. Kranthi Kiran et al. – IJRASET, 2024

Summary: This work used transfer learning with VGG16 CNN for facial emotion detection. Detected emotions were mapped to playlists for personalized music recommendations.

Merits: Transfer learning improves accuracy and reduces training time, enabling reliable emotion recognition.

Demerits: The system is limited to music recommendations and lacks versatility for suggesting other activities.

4. Paper Name: Facial Emotion Detection Using CNN and OpenCV

Author: R.M.R. Raut, S.N. Deshmukh – IJERT, 2020

Summary: A lightweight CNN model integrated with OpenCV for real-time webcam-based emotion detection was proposed. The model is trained on the FER2013 dataset and designed for fast deployment.

Merits: Lightweight, fast, and easily integrable with applications, suitable for real-time systems.

Demerits: Limited accuracy (~65–75% on FER2013) and reduced robustness under poor lighting or occluded faces.

3. METHODOLOGY

The proposed Smart Emotion-Based Activity Recommendation System combines deep learning-based facial emotion recognition with Gemini AI to provide personalized activity suggestions. The system is implemented as a web-based application that supports real-time webcam input as well as image uploads. The methodology is divided into the following key steps:

i. **Image Acquisition:**
The system captures input through a live webcam feed or an uploaded image. For real-time emotion detection, the webcam continuously streams frames that are processed by the system for face detection.

ii. **Face Detection and Preprocessing:**
Faces are detected using the Haar Cascade classifier. Detected facial regions are converted to grayscale and resized to a standardized dimension to ensure consistency for the CNN model. Preprocessing also includes normalization and noise reduction to improve model accuracy.

iii. **Emotion Classification Using CNN:**
A single Convolutional Neural Network (CNN) model is employed for emotion recognition. The CNN comprises convolutional layers with ReLU activations, max-pooling layers for dimensionality reduction, dropout layers to prevent overfitting, and fully connected layers for classification. The model is trained on standard datasets

and optimized for detecting six basic emotions: happiness, sadness, anger, fear, surprise, and neutral.

iv. Attribute Extraction:
In addition to emotion, the system extracts other facial attributes such as age, gender, and confidence scores using DeepFace. These attributes enhance the context for personalized recommendations.

v. Activity Recommendation Using Gemini AI:
The extracted emotion and attributes are passed to Gemini AI. Using a generative prompt, Gemini AI provides personalized suggestions including activities, music, movies, and motivational quotes tailored to the detected emotional state.

vi. Display and Feedback:
The front-end interface displays the detected emotion and the corresponding activity recommendations in real-time. This provides an interactive experience that adapts dynamically to changes in the user's facial expressions.

vii. Deployment:
The system is implemented using Flask, OpenCV, DeepFace, and Gemini AI. It supports a seamless pipeline from image acquisition to emotion detection and activity recommendation, ensuring real-time responsiveness and accurate user engagement.

4. SYSTEM DESIGN

The proposed system is a Smart Emotion-Based Activity Recommendation System that detects a user's emotion through facial expressions and suggests personalized activities, music, movies, and motivational quotes. The system is implemented as a web-based application using Python (Flask framework), OpenCV, DeepFace, and Google Gemini AI. The design emphasizes real-time emotion detection via webcam and image upload mode for flexibility.

4.1. System Architecture Overview

The system consists of the following major modules:

a) User Interface Module (Front-End)
- Provides two modes for the user:
  - Camera Mode: Live webcam feed for real-time emotion detection.
  - Upload Mode: Allows users to upload an image for emotion analysis.
- Built using HTML, CSS, and JavaScript templates in Flask.
- Displays detected emotion, gender, and recommended activities to the user.

b) Web Server Module (Back-End)
- Built using Flask.
- Handles HTTP requests from the front-end, including mode selection, video feed, and image upload.
- Initializes and manages the webcam for live detection.
- Returns JSON responses containing detected emotions and suggested activities.

c) Emotion Detection Module
- Uses OpenCV Haar Cascade Classifier for face detection.
- Uses DeepFace library to analyze the detected face for:
  - Dominant Emotion (e.g., happy, sad, angry)
  - Gender
  - Age
  - Confidence level of detection
- Handles errors if no face is detected or frame capture fails.

d) Activity Recommendation Module
- Integrates Google Gemini AI (Gemini 1.5) through a custom Python module (bard.py).
- Sends detected emotion, gender, and other face attributes to Gemini.
- Gemini generates personalized suggestions, including:
  - Recommended activity
  - Music suggestion
  - Movie suggestion
  - Motivational quote

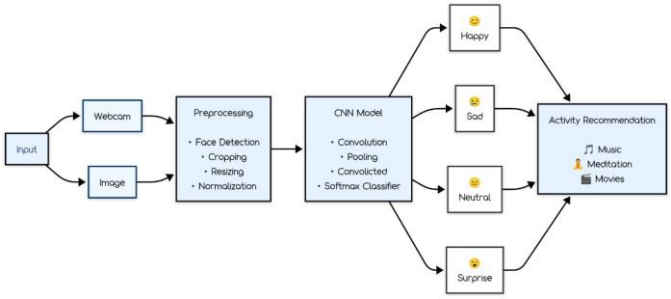

Fig -1: **Architecture Diagram**

4.2. Data Flow

i. The user accesses the web interface and selects a mode (Camera or Upload).
ii. The server either initializes the webcam (Camera Mode) or processes the uploaded image (Upload Mode).
iii. The Emotion Detection Module detects faces and extracts emotions, gender, age, and confidence.

iv. The Activity Recommendation Module sends this data to Gemini AI, which returns personalized suggestions.

v. The server sends JSON data to the front-end, which displays:
- Detected emotion and gender
- Suggested activity, music, movie, and motivational quote

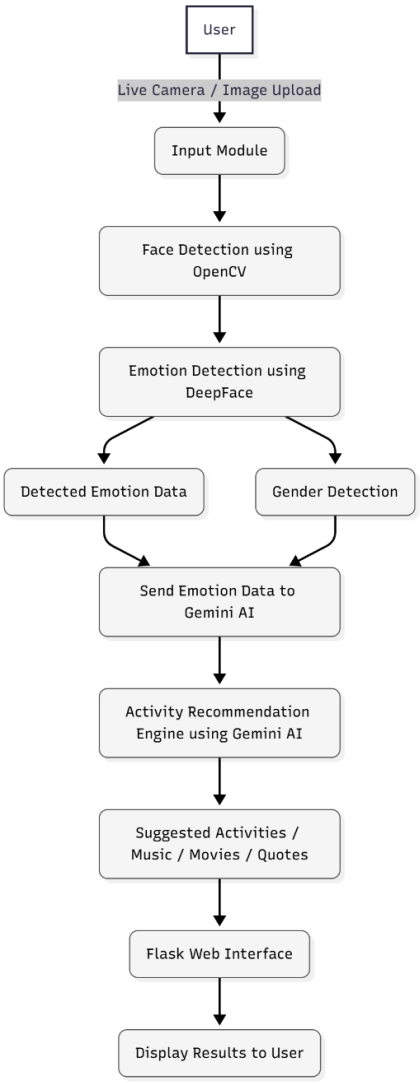

Fig -2: Data Flow Diagram

RESULTS

The system was tested on multiple subjects under varying lighting conditions. The key observations include:

- Emotion Detection Accuracy: DeepFace accurately recognized basic emotions such as happiness, sadness, anger, surprise, fear, disgust, and neutral states with high reliability.
- Gender Recognition: Gender identification was performed accurately for both live and uploaded images.
- Activity Recommendations: Gemini AI provided relevant activity suggestions, music, movie recommendations, and motivational quotes based on the detected emotion. For example:
  - Emotion Detected: Happy
  - Suggested Activity: Go for a walk in the park to maintain positivity.
  - Music Recommendation: Upbeat pop songs.
  - Movie Recommendation: Light-hearted comedy movies.
  - Motivational Quote: "Happiness is not something ready-made. It comes from your actions."

The system successfully displayed the live video feed with bounding boxes around detected faces and real-time updates of detected emotions and suggested activities. Uploaded images also provided accurate detection and recommendations.

Performance Metrics:

- Real-time camera mode latency: ~0.5–1.5 seconds per frame.
- Image upload processing time: ~1–2 seconds per image.
- User-friendly interface allowed seamless switching between camera and upload modes.

In Camera Mode:

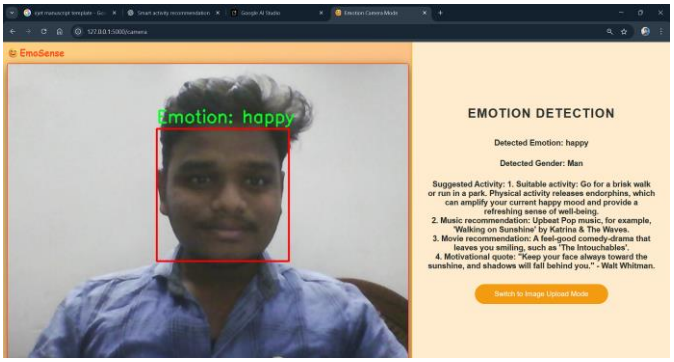

Fig -3: Output (Happy)

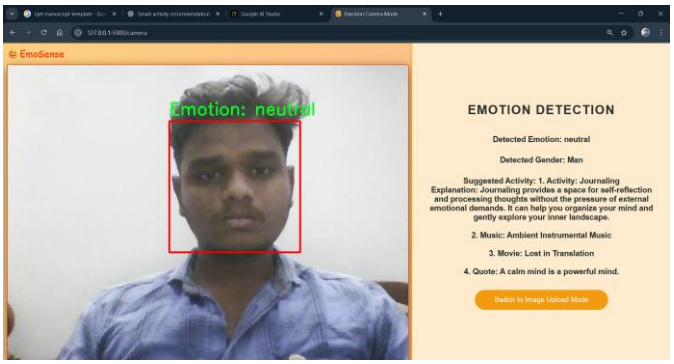

Fig -4: Output (Neutral)

In Image Upload Mode:

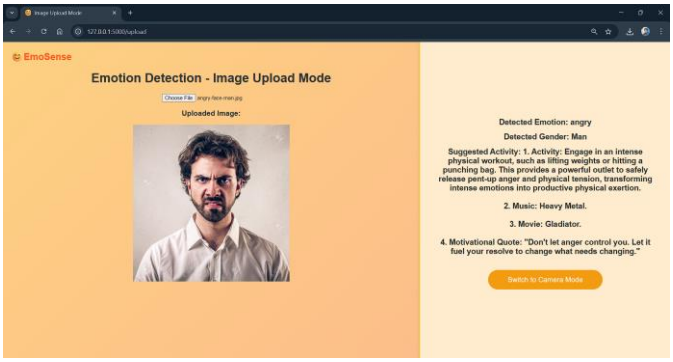

Fig -5: Output (Angry)

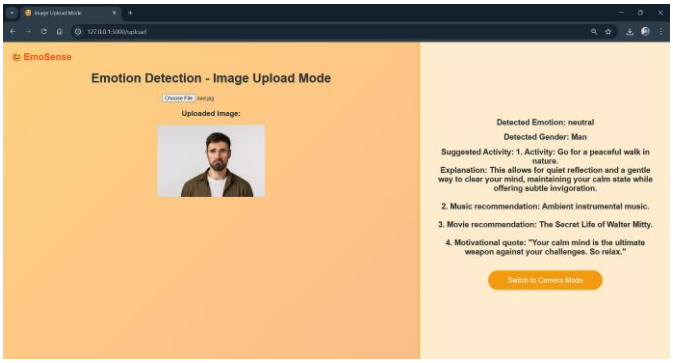

Fig -6: Output (Sad)

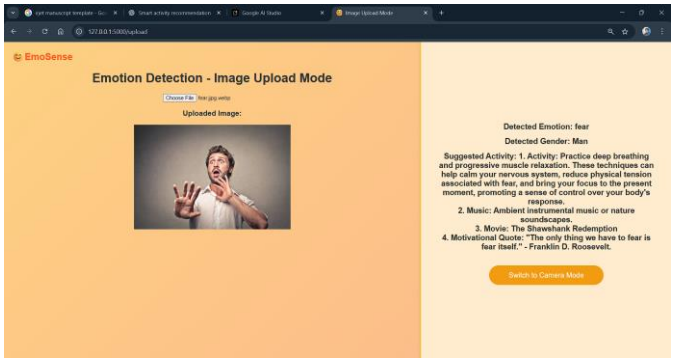

Fig -7: Output (Fear)

5. CONCLUSIONS AND FUTURE SCOPE

The proposed Smart Emotion-Based Activity Recommendation System effectively combines deep learning-based emotion detection and AI-powered activity recommendation to provide personalized suggestions. The system demonstrates:

- **High Accuracy:** Reliable emotion and gender detection through DeepFace.
- **Personalization:** Gemini AI generates tailored suggestions including activities, music, movies, and quotes.
- **Versatility:** Both live camera and image upload modes are supported.
- **Practical Utility:** Can be extended to mental health monitoring, mood-based content recommendation, and interactive human-computer interfaces.

Future work may focus on integrating multi-modal inputs such as voice or text-based emotion detection, improving latency, and expanding the recommendation database to include lifestyle, fitness, and educational activities

REFERENCES

[1] Garima Verma and Hemraj Verma, "Hybrid Deep Learning Model for Emotion Recognition Using Facial Expressions," Springer Journal, 2020. DOI: 10.1007/s12626-020-00061-6.

[2] S. Agrawal and S. Choudhary, "Real-Time Emotion Detection using Deep Learning Techniques," 2021 International Conference on Computer, Communication, and Electronics (ICCES), pp. 17–22, 2021. DOI: 10.1109/ICCES54031.2021.96861082.

[3] S. Minooe, A. Abdar, et al., "Deep Facial Expression Recognition: A Survey," IEEE Transactions on Affective Computing, Vol. 12, No. 3, 2021. DOI: 10.1109/TAFFC.2021.3075993.S.

[4] A. B. Hassan, "Emotion Recognition Using CNN and RNN with SVM Classifier," International Journal of Advanced Computer Science and Applications (IJACSA), Vol. 11, No. 5, 2020.

[5] R. M. Raut and S. N. Deshmukh, "Facial Emotion Detection using CNN and OpenCV," International Journal of Engineering Research & Technology (IJERT), Vol. 9, Issue 06, June 2020.

[6] Agung E. S., "Image-based Facial Emotion Recognition Using Deep Learning Models," *Scientific Reports*, 2024.

[7] Mellouk W., "Facial Emotion Recognition Using Deep Learning," *Procedia Computer Science*, 2020.

[8] Ganesan P., "Facial Expression Recognition Using SVM With CNN and Handcrafted Features," *International Journal of Recent Technology and Engineering (IJRTE)*, Vol. 8, Issue 4, 2019.

[9] Kim J. C., "Hybrid Approach for Facial Expression Recognition Using CNN and SVM," *Applied Sciences*, 2022.

[10] Singh R., "Facial Expression Recognition in Videos Using Hybrid CNN and ConvLSTM," *Frontiers in Computer Science*, 2023.