ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/24apr1755

EmoDetect: ML Based Facial Assessment of Anxiety & Depression

Bharati Gondhalekar[1]; Suraj Mahato[2]; Sahil Salian[3]; Hrishikesh Adhau[4];

[1,2,3,4]Department of Information Technology Vidyavardhini's College of Engineering and Technology

Publication Date: 2025/06/30

Abstract: EmoDetect is an innovative online application de- signed to provide real-time emotion analysis and mental health monitoring through facial expression recognition. In today's digi- tal age, where mental health concerns are increasingly prevalent, EmoDetect offers a user-friendly platform for individuals to gain insights into their emotional well-being. Leveraging state- of-the-art deep learning techniques and the Deep Face library, EmoDetect accurately detects and analyzes facial expressions to determine users' emotional states. The application allows users to upload video files or utilize their webcam for real- time emotion analysis. EmoDetect calculates depression and anxiety scores based on detected emotions, providing users with personalized insights into their mental health status. Through intuitive visualizations, users can explore the distribution of emotions over time and gain a deeper understanding of their emotional patterns. EmoDetect not only empowers users to track their emotional well-being but also provides actionable recom- mendations, such as personalized music playlists, to uplift their mood. Furthermore, the application facilitates data storage and report generation, enabling users to track their emotional journey over time. In this paper, we present the architecture, methodology, and key features of EmoDetect, along with experimental results demonstrating its effectiveness in emotion analysis and mental health monitoring. We discuss the implications of our findings for mental health care and highlight potential avenues for future research and application development in this domain.

Keywords: *Mental Health, Anxiety, Depression, Facial Ex- Pression Analysis, Machine Learning, Deep Face Library.*

How to Cite: Bharati Gondhalekar; Suraj Mahato; Sahil Salian; Hrishikesh Adhau; (2025) EmoDetect: ML Based Facial Assessment of Anxiety & Depression. *International Journal of Innovative Science and Research Technology*, 9(4), 3444-3453. https://doi.org/10.38124/ijisrt/24apr1755

I. INTRODUCTION

Anxiety and depression are two major mental health ill- nesses that impact millions of people worldwide and have a huge negative impact on society. The World Health Organiza- tion (WHO) states that anxiety disorders are among the most common mental health diseases and that they significantly re- duce productivity and quality of life. Depression is the primary cause of disability globally. Even with the growing awareness of the significance of mental health, it is still difficult to diagnose mental health illnesses promptly and accurately, which frequently leads to misdiagnosis, underdiagnosis, and treatment delays. Typically, subjective self-reporting or clinical assessments are used in traditional techniques of diagnos- ing anxiety and depression. These approaches have inherent limitations due to factors like recollection biases, subjective interpretation, and the availability of qualified specialists. The disparity in mental health care is further exacerbated by the fact that many people find it difficult to receive mental health services because of things like stigma, resource scarcity, and barriers to care. All things considered, Emo Detect is a note- worthy development in the realm of mental health assessment, providing a viable path toward bettering the prompt detection and treatment of anxiety and depression.

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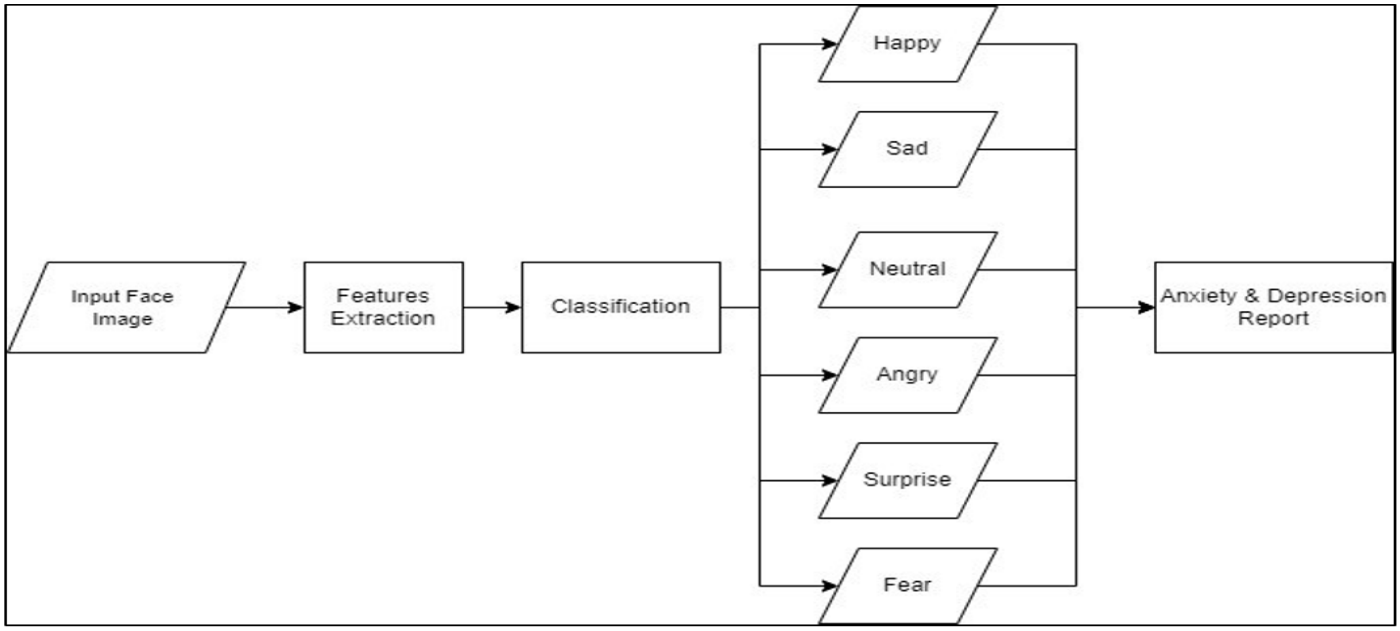

Fig 1 Block Diagram

Overall, the block diagram of Emo Detect demonstrates a comprehensive approach to ML-based facial assessment of anxiety and depression, encompassing data acquisition, pre- processing, feature extraction, machine learning modeling, classification, post processing, and visualization stages. This framework provides a systematic and effective methodology for analyzing facial expressions and inferring individuals Emo- tional states, thereby facilitating objective and non-invasive assessment of mental health conditions.

II. LITERATURE REVIEW

Recent studies have demonstrated advancements in emotion analysis and mental health monitoring through the integra- tion of innovative techniques and methodologies. One such study adeptly discerned features across anxiety, stress, and depression classes, showcasing the potential for comprehen- sive emotion analysis. Pre-processing techniques have been shown to play a crucial role in elevating video frame quality, thereby aiding feature extraction processes (Reference). For instance, the use of the Kalman-filter-assisted Kanade-Lucas- Tomasi algorithm has facilitated facial extraction and feature point identification, contributing to more accurate emotion analysis results. In terms of statistical analysis, previous stud- ies have employed descriptive statistics to capture means, standard deviations, and percentages for both quantitative and qualitative variables (Reference). Non-parametric tests have also been utilized for hypothesis testing, particularly due to non-normal distribution of data, with tests such as Mann Whitney U for two-group comparisons, Kruskal-Wallis for three or more groups, and Spearman's rank correlation for measuring variable correlations. Furthermore, integrating information extracted from different modes has shown promise in significantly improving the accuracy of emotion evaluation, a novel approach not extensively reported in previous studies (Reference). For example, a method presented in literature achieved over 74% Pearson similarity between Body Dysmor- phic Disorder (BDD) and well-established self-rating depres- sion and anxiety scales, such as the Self-rating Depression Scale (SDS), Self-rating Anxiety Scale (SAS), and Hamil- ton Depression Scale (HAMD) (Reference).Additionally, this method effectively tracked and evaluated changes in BDD among patients at different stages of treatment, with results aligning with evaluations from standard scales. These find- ings underscore the importance of innovative methodologies and integrated approaches in advancing emotion analysis and mental health monitoring, providing valuable insights for the development of systems such as EmoDetect.

III. RELATED WORK

The block diagram of Emo Detect illustrates the systematic approach used for the ML-based facial assessment of anxiety and depression. The diagram consists of several interconnected components, each contributing to the overall functionality of the framework.The existing systems described in the literature survey above encompass a diverse range of applications within the realm of image classification and deep learning.[1] These systems are designed to tackle specific challenges, from new class detection to e-commerce product recognition, facial image recognition, and document image classification.[2] They emphasize the critical role of deep learning, particularly convo- lutional neural networks (CNNs), in handling complex image data and improving accuracy across various domains. Many of these systems achieve remarkable results, with accuracy rates exceeding 90Emo Detect seeks to build upon existing methodologies and techniques to design a comprehensive framework for ML-based facial assessment of anxiety and depression. The framework aims to provide clinicians and researchers with a valuable tool for objective and non-invasive mental health assessment, thereby facilitating early detection, monitoring, and intervention for individuals with mental health conditions.

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IV. PROPOSED SYSTEM

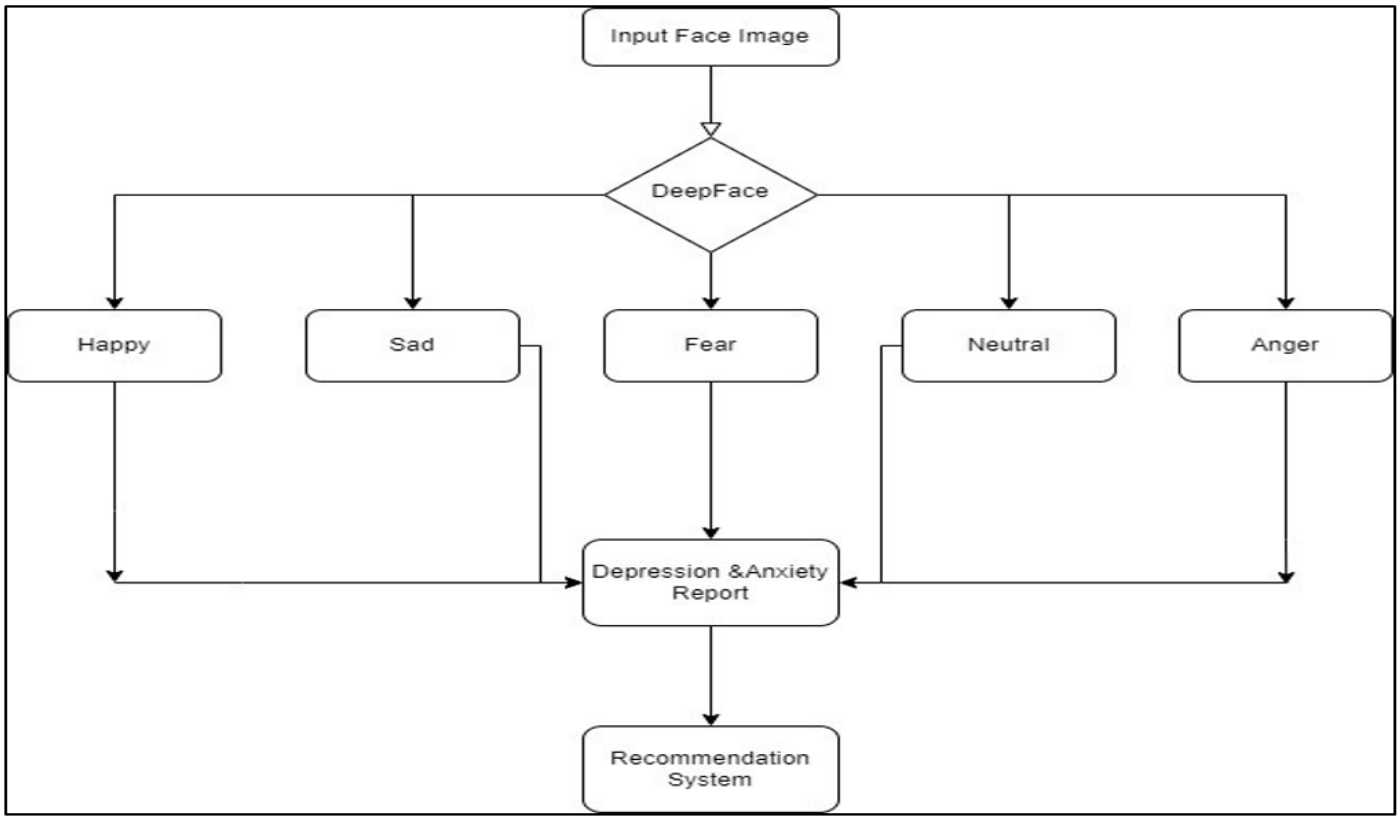

Fig 2 EmoDetect Flowchart

A. Live Emotion Analysis:

The proposed Emo Detect system integrates a real-time facial expression recognition component, enabling users to interact with the system through their webcam. Upon ex- ecution of the code, the system initiates by activating the camera functionality, capturing live facial images of the user. These images are then processed through the deep learning model, which analyzes various facial expressions in real-time to detect and display multiple emotions on the screen based on the user's expressions. This interactive feature allows users to witness the system's ability to accurately recognize and respond to their emotional states instantaneously. Through this dynamic interaction, Emo Detect aims to provide users with a personalized and engaging experience, showcasing the capabilities of facial expression analysis in assessing emotional well-being. The system's seamless integration of real-time facial recognition technology and emotion detection algorithms demonstrates its potential as a valuable tool for objective mental health assessment and intervention.

By leveraging advancements in deep learning and computer vision, Emo Detect offers a user-friendly interface for indi- viduals to gain insights into their emotional states and foster awareness of mental health.

B. Deep Learning Authentication:

The authentication of deep learning in Emo Detect is a crucial aspect ensuring the reliability and effectiveness of the facial expression recognition system. This authentication process encompasses several key elements to validate the performance and ethical considerations of the deep learning model. Firstly, the model undergoes extensive training using annotated datasets of facial expressions associated with anxi- ety, depression, and neutral states. Through optimization of model parameters and validation techniques such as cross- validation, the model's performance is rigorously evaluated and refined to accurately classify emotional states based on extracted facial features.

C. Buyer Role:

In the Emo Detect project, buyers play a pivotal role in the adoption and utilization of the facial expression recognition system. As end-users of the technology, buyers are primarily responsible for interacting with the system and leveraging its functionalities for personal or professional purposes. Buyers have the opportunity to engage with the Emo Detect system through various channels, including web-based platforms or mobile applications, where they can access the real-time facial expression recognition feature. By interacting with the system, buyers provide valuable feedback on the user experience, functionality, and performance of Emo Detect, contributing to its continuous improvement and refinement. Additionally, buyers may also play a role in the broader adoption of the technology by advocating for its use within their respective communities or organizations. Through their engagement and feedback, buyers play an integral role in shaping the usability, effectiveness, and societal impact of the Emo Detect facial expression recognition system.

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V. IMPLEMENTATION AND RESULT

A. User Friendly Interface where Emotions Are Detected

The implementation of Emo Detect involved the develop- ment of a real-time facial expression recognition system using deep learning techniques. The system was implemented using Python programming language and popular deep learning libraries such as TensorFlow and Keras.

B. CNN model for Capturing Facial Emotions

The model used for Emo Detect, particularly in the context of real-time capturing of facial emotions, is typically a variant of a Convolutional Neural Network (CNN) combined with techniques for real-time processing. CNNs are well-suited for image recognition tasks, including facial expression recogni- tion, due to their ability to automatically learn relevant features from input images.

Fig 3 Disgust

Fig 4 Sad

Fig 5 Neutral

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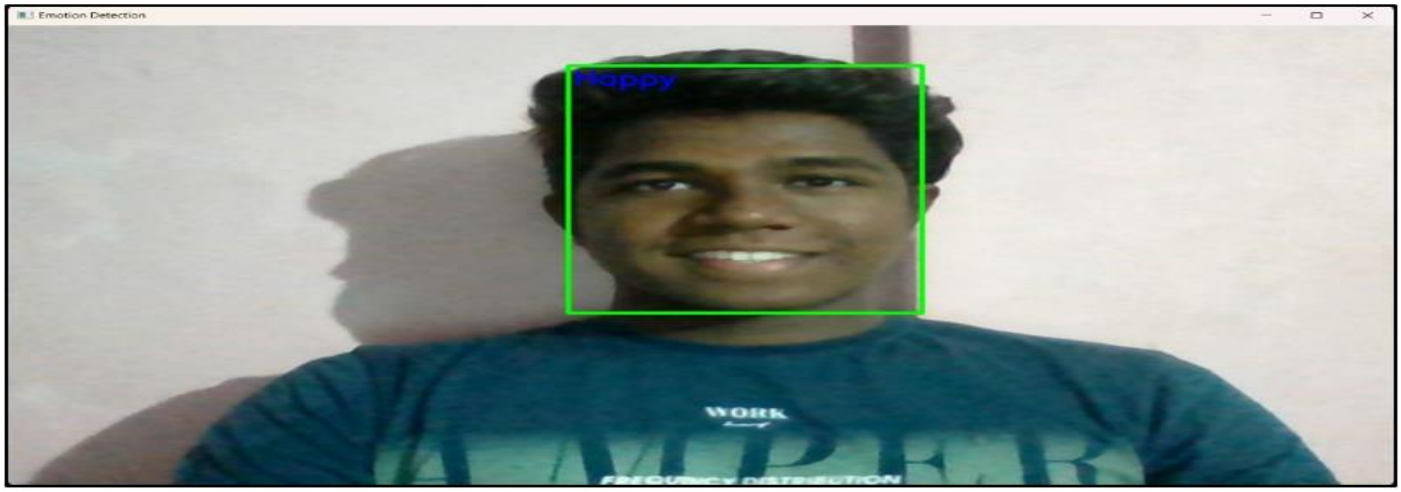

Fig 6 Happy

VI. ANALYSIS

The Emo Detect project uses deep learning techniques, specifically Convolutional Neural Networks (CNNs), to analyze facial expressions in order to propose a novel approach to mental health screening. Emo Detect shows promise efficacy in reliably identifying and categorizing emotional states, such as anxiety and depression, based on facial expressions by utilizing CNNs. Instantaneous input on emotional states is made possible by the system's real-time processing capa- bilities, which improve user engagement and usability in a variety of applications, such as telemedicine and human- computer interaction. However, the initiative also brings up significant ethical issues with relation to informed consent, bias mitigation, and data privacy. It is imperative that steps be taken to resolve these moral issues and guarantee the privacy and rights of persons.

Furthermore, difficulties in generalizing the model and using facial expressions as the only means of identifying emotional states emphasize the necessity for additional study and ad- vancement. In order to integrate Emo Detect into evidence- based methods for mental health assessment and intervention and to evaluate its efficacy in real-world clinical settings, collaborations with mental health practitioners and stakehold- ers are needed. Overall, the Emo Detect study highlights the significance of ethical considerations and future research avenues while also representing a promising development in objective mental health screening through facial expression analysis.

VII. RESULTS AND ANALYSIS

A. User-Friendly Interface:

- EMO Detect boasts a sleek and intuitive user interface, prioritizing ease of navigation and accessibility.
- Designed with user experience in mind, the interface ensures seamless interaction for users of all proficiency levels.

B. Video Upload Functionality:

- The core functionality of EMO Detect revolves around uploading videos for emotion analysis.
- Users can effortlessly upload videos directly from their device by browsing through files and directories.
- Supported file formats include common video extensions such as MP4, AVI, MOV, and more.

C. Browsing Integration:

- EMO Detect streamlines the video selection process by integrating a browsing feature.
- Users can explore their device's files and directories

D. Real-Time Feedback:

- Upon video upload, EMO Detect provides real-time feedback on emotion analysis.
- Users can instantly view results, including emotional insights derived from the uploaded video.
- This feature facilitates quick interpretation and understanding of emotional content within the video.

E. Customization Options:

- EMO Detect offers customization options to tailor the analysis according to user preferences.
- Users can adjust parameters such as sensitivity levels and emotional categories for personalized results.
- This flexibility ensures that users can fine-tune the analysis to meet specific requirements and objectives.

F. Compatibility and Accessibility:

- EMO Detect is designed to be compatible with various devices and platforms, ensuring broad accessibility.
- Whether accessing the tool via desktop, laptop, or mobile device, users can enjoy consistent performance and functionality.
- Cross-platform compatibility enhances usability, enabling users to leverage EMO Detect across different environments seamlessly.

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Fig 7 User Interface

It is an innovative tool designed to analyze emotions por- trayed in videos. With its user-friendly interface, users can eas- ily upload videos for comprehensive emotional analysis. The interface seamlessly integrates browsing capabilities, allowing users to select videos from their device's files or directories with convenience.

$$\text{Depression\_score} += \left(\frac{\text{(angry + sad + 0.5 × fear)}}{\sum \text{emotions\_scores. values() or 1}}\right) \times 100 \quad (1)$$

$$\text{Anxiety\_score} += \left(\frac{\text{(fear + 0.5 × angry + sad)}}{\sum \text{emotions\_scores. values() or1}}\right) \times 100 \quad (2)$$

This feature enhances efficiency and convenience, en- abling users to locate and select desired videos with ease.

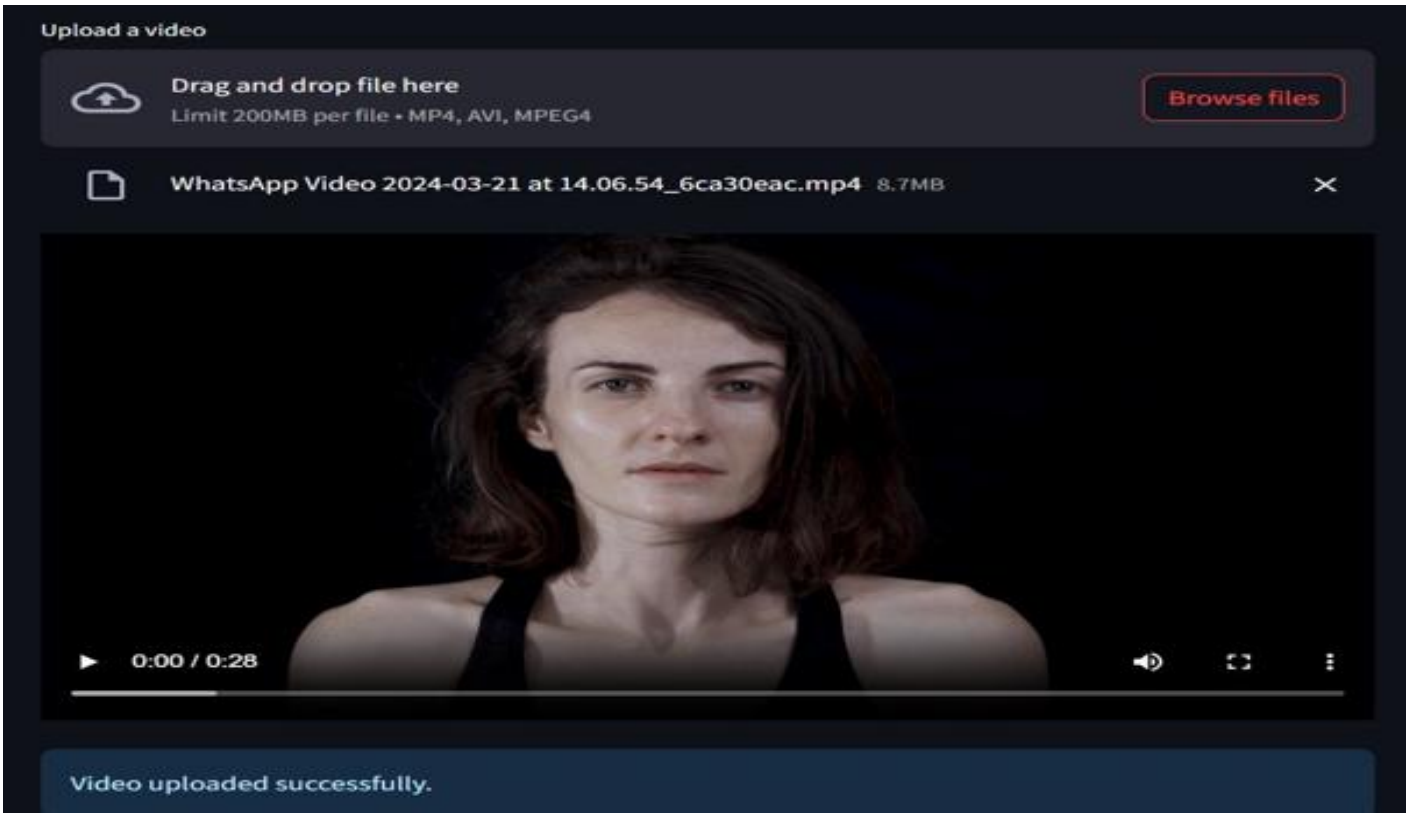

Fig 8 Video Demonstration

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It's a cutting-edge emotion analysis tool made to offer per- ceptive analyses of the feelings portrayed in videos. Uploading films for analysis is made easier using EMO Detect's user- friendly interface. Users can choose and upload videos that effectively portray a variety of emotions with ease thanks to the seamless integration of browsing features.

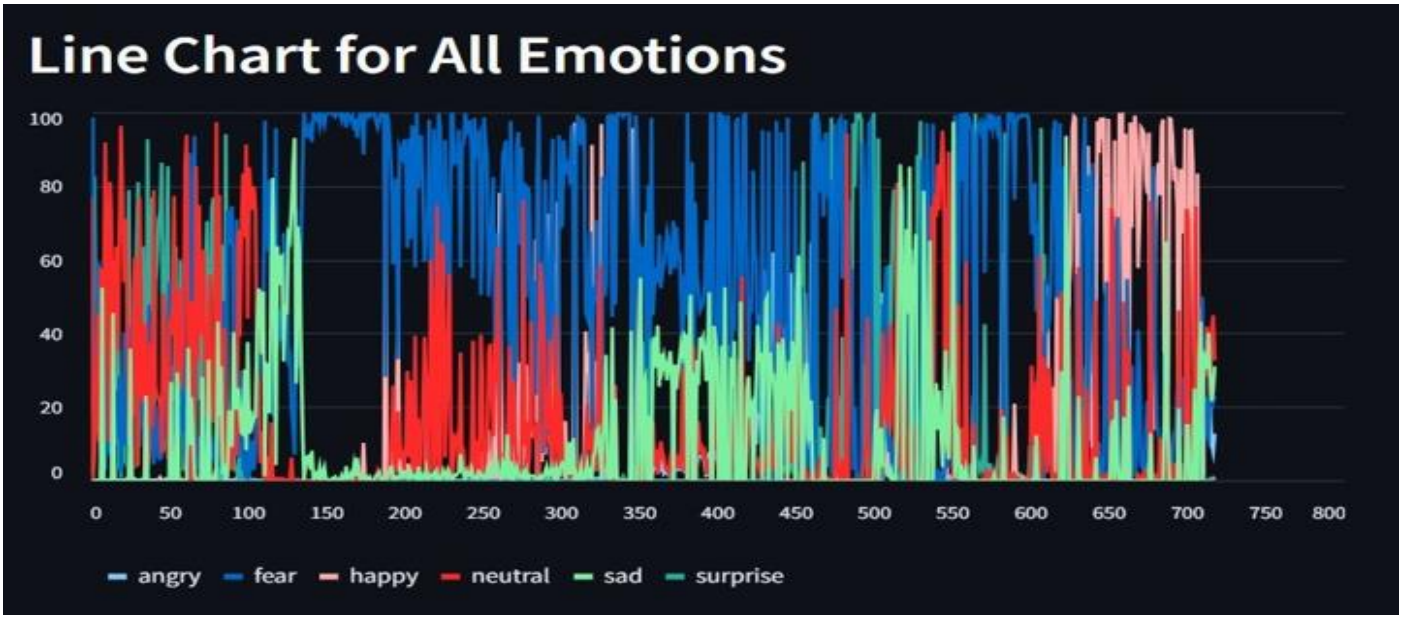

Fig 9 Line Chart

We use line charts in EMO Detect to provide a visual depiction of the emotional changes that occur in a video. It's essential to comprehend these line charts in order to fully appreciate the emotional journey that the video portrays.

Pie charts are used by EMO Detect to show how different emotions are distributed throughout a video. To have an understanding of the entire emotional composition of the video, it is important to comprehend these pie charts.

Anxiety and depression analysis tool's report creation fea- ture offers in-depth insights into a person's mental health status, with a particular focus on symptoms associated with anxiety and depression. Our application produces comprehen- sive reports to help with anxiety and depression diagnosis, therapy planning, and monitoring by utilizing cutting-edge algorithms and data analysis approaches.

EMO Detect recommendation tool provides personalized advice and recommendations based on the emotional insights found in the videos that are examined. EMO Detect makes practical suggestions to improve emotional comprehension, communication, and storytelling by utilizing complex algo- rithms and psychological concepts.

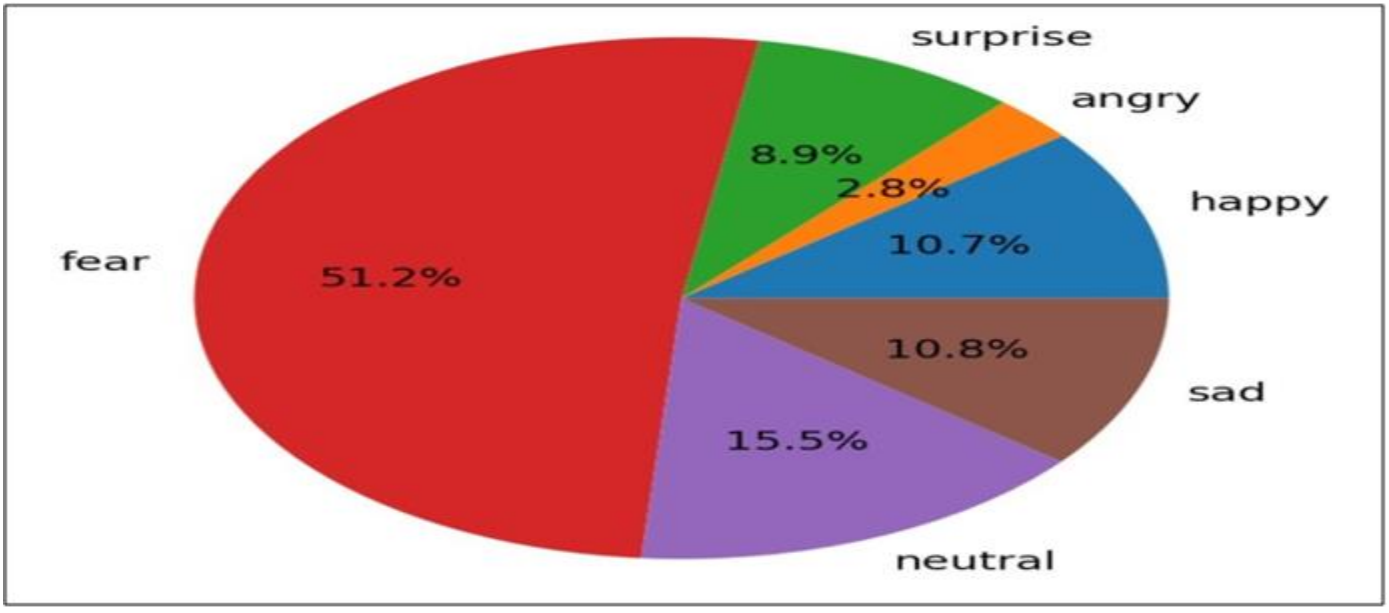

Fig 10 Pie Chart

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Fig 11 Report Generation

VIII. CONCLUSION

In conclusion, the Emo Detect project marks a significant milestone in the realm of mental health assessment by harness- ing the power of deep learning for real-time facial expression analysis. This innovative approach offers a promising avenue for objective evaluation of emotional states, with a particular focus on anxiety and depression. Through the utilization of Convolutional Neural Networks (CNNs) and real-time pro- cessing capabilities, Emo Detect provides a non-invasive and accessible means of assessing individuals' emotional well- being. Moreover, the integration of real-time facial emotion recognition into user-friendly interfaces enhances usability and engagement, making Emo Detect a versatile tool for various applications, including tele medicine, human-computer interaction, and user experience research. However, while Emo Detect shows great promise, several challenges and considera- tions must be addressed for its successful implementation and widespread adoption. Ethical considerations surrounding data privacy, bias mitigation, and informed consent are paramount and require careful attention to ensure the protection of indi-viduals' rights and well-being. Additionally, efforts to address challenges related to model generalization, expand the scope of emotional states beyond anxiety and depression, and validate the effectiveness of the technology in diverse populations are crucial for its broader applicability. Moving forward, continued research and collaboration with mental health professionals and stakeholders will be essential to refine the technology, address ethical considerations, and integrate Emo Detect into evidence-based practices for mental health assessment and intervention. By navigating these challenges and leveraging the potential of deep learning for facial expression analysis, Emo Detect has the opportunity to make a meaningful impact on mental health care, facilitating early detection, intervention, and personalized care for individuals worldwide.

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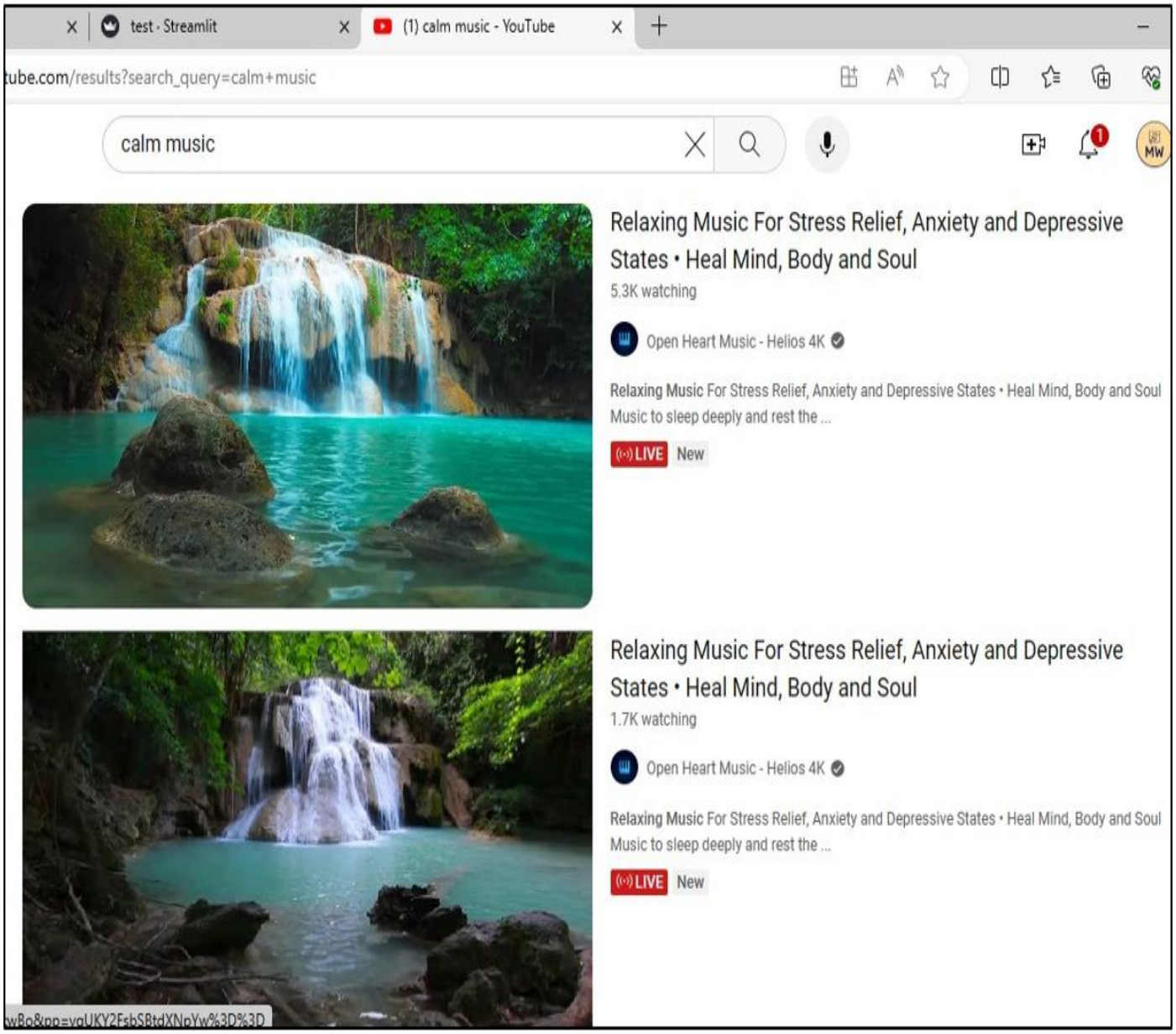

Fig 12 Recommendations

Table 1 Comparison of Literature Review with EmoDetect Advantages

Literature Review	EmoDetect Advantages
Recent studies demonstrate ad- vancements in emotion analysis and mental health monitoring.	EmoDetect provides real-time emotion analysis and mental health monitoring.
Pre-processing techniques enhance video frame quality for accurate feature extraction.	EmoDetect integrates pre- processing techniques to improve emotion analysis results.
Utilizes the Kalman-filter-assisted Kanade-Lucas-Tomasi algorithm for facial extraction and feature point identification.	EmoDetect leverages advanced deep learning techniques, particularly the DeepFace library, for facial expression recognition.
Previous studies employ descrip- tive statistics and non-parametric tests for hypothesis testing.	EmoDetect offers statistical analy- sis capabilities, including descrip- tive statistics and hypothesis test- ing methods.
Integration of information from different modes improves the accu- racy of emotion evaluation.	EmoDetect integrates data from various sources to enhance emotion analysis accuracy.
Method achieves over 74% Pear- son similarity with established de- pression and anxiety scales.	EmoDetect provides accurate de- pression and anxiety scores, corre- lating well with established scales.
Effective tracking and evaluation of changes in emotional states over treatment stages.	EmoDetect facilitates tracking of emotional changes over time, aid- ing in treatment monitoring.

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