A Sustainable and Scalable AI Model for Facial Emotion Detection in Android Applications

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Abstract— The emotion detection is the key requirement in the field of human-computer interaction. There has been considerable interest in the application areas of mental health, smart educational environments, and user experience. However, the traditional process of emotion detection is time-consuming, wherein the task is carried out manually, through surveys, or rule-based techniques that are not efficient. Therefore, to overcome these problems, the current project aims to develop FACE FEEL AI, which is an emotion classification system for the Android platform, employing image learning models to perform facial emotion detection. The proposed system allows a user to recognise emotions in the facial image taken by the mobile camera or choose from the album. A machine learning model trained by Teachable Machine is embedded in the Android App in order to classify emotions such as happiness, sadness, anger, surprise, and neutrality. In this system, the input image is pre-processed for emotion recognition in the mobile environment. FACE FEEL AI is intended to be lightweight, fast, and friendly to use so as to run with ease in real-time without requiring any specialised hardware or any controlled environment. The application will offer immediate results of emotion recognition through an interactive interface. This increases accuracy, consistency, and accessibility as opposed to human intervention, which is analysed through automation in the proposed system. The tool provides a realistic and efficient approach towards the problem of detecting emotions. The tool would greatly benefit areas such as the provision of mental health assistance, smart learning platforms, and intelligent human computer interaction systems.

Keywords: Emotion Classification, Facial Emotion Recognition, Android Application, Image Learning Models, Teachable Machine, Real-Time Emotion Detection, Camera and Gallery Images.

I. INTRODUCTION

Emotions have been identified as playing a crucial part in human behaviour and decision-making processes. The requirement to identify and analyse human emotions is essential in applications like mental health tracking systems, human-computer interaction, smart education platforms, and user experience analysis. The increasing adoption of mobile and artificial intelligence technology is allowing human emotion recognition systems to shift from manual processing methods to intelligent systems capable of processing emotions in real time. The conventional techniques of emotion detection were largely dependent on human observation, psychological tests, or the rules of facial observation. It was a subjective, time-consuming, and less accurate process, especially in a dynamic environment. Another drawback of the conventional emotion detection systems is that they often need a laboratory environment, which is unfeasible in this modern era. Hence, a portable, efficient, and user-friendly emotion detection system is in high demand, especially in mobile devices. Recent technological improvements in machine learning techniques and image processing allow computers to be able to learn complicated facial patterns of various emotions. These image learning algorithms, when trained from facial expression images, are able to recognise emotions like happiness, sadness, anger, surprise, fear, and neutrality. Technologies such as Teachable Machine now make the development of these models more efficient, so that minimal processing is involved in the application. In this respect, FACE FEEL AI is proposed to be an Android-based emotion

classification system that applies image learning models to identify emotions from facial images. The system enables users to take real-time images using the smartphone camera or select an image from the gallery on the mobile device. The image is then processed to be instantly analysed by a trained machine learning model to determine the expressed emotion on the face. The proposed system is optimised to be fast and easy to use on an Android device. FACE FEEL AI hopes to address the shortcomings in current emotion detection systems through the use of mobile computing, image-based ML, and real-time processing. This proposed system will serve as an efficient, precise, and viable solution that has the wide range of applicability in various areas such as mental health evaluation, smart learning environments, and intelligent human-computer interaction.

II. LITERATURE REVIEW

This article proposes an Android-based facial emotion recognition system for classifying human emotions via facial images utilizing Convolutional Neural Network (CNN). The authors aim to develop a lightweight deep learning model for facial emotion recognition, which can easily run on Android devices. The facial images are taken by making use of a smartphone camera and processed through face detection and normalization techniques, which are further processed by a CNN model trained on FER-2013 to identify facial emotions like happiness, sadness, anger, fear, surprise, and neutrality. The authors have employed TensorFlow Lite to optimize their deep learning model for execution on Android devices to provide faster processing capacity despite limited resources. The experimental evidence confirms its appropriateness for accurate processing despite a lack of latency and memory usage, making it applicable for successful execution on Android devices. This paper throws light upon the successful execution of deep learning-based facial emotion detection systems intended for Android devices to process facial emotions without resorting to cloud computing for enhanced user convenience and privacy preservation.[1]

This thesis explores the execution of emotion detection in real time on an Android smartphone via the analysis of facial expressions. The proposed emotion detection system uses the front-side camera of the smartphone to capture live frames from the video stream and employ face detection algorithms to identify the region of interest corresponding to the face. Machine learning and deep learning approaches are used to classify the emotions in the captured frames in real time. The research specifically brings forth the aspect of performance optimization to satisfy the constraints of limited computing resources on the smartphone, including the computing power and battery life. This research provides insights and practical knowledge about the associated system design considerations and challenges of executing emotion recognition algorithm tasks on an Android smartphone.[2]

This paper presents a review of the techniques related to face emotion recognition, with special attention to mobile and Android devices. More precisely, the authors analyze traditional machine learning methods and modern deep learning approaches, including CNN-based architectures, discussing their suitability for deployment on resource-constrained platforms. Key aspects reviewed concern face detection, feature extraction, emotion classification, datasets, and evaluation metrics. Quite importantly, special attention is given to model compression, TensorFlow Lite, and on-device inference as crucial for real-time mobile applications. The paper also discusses challenges such as lighting variations, occlusions, computational limitations, and privacy concerns. By comparing several approaches and best practices, this study provides a valuable reference to researchers and developers for the design and implementation of efficient emotion recognition systems to be deployed on Android smartphones and other mobile devices.[3]

This paper presents an Android app for facial expression recognition using deep learning. The authors have designed and developed a CNN model to detect various facial expressions of images taken through the camera of a smartphone. The authors have included facial detection, image processing, emotion detection, and output display for the Android app to display to its user. The trained model has been repackaged for smooth execution of the model running on Android devices. The model has been proven theoretically to have accurate classification and real-time processing capability. This paper shows effective app design and deployment for developing effective

emotion detection apps. This paper presents effective usage of deep learning models for developing Android apps. This paper can be used for developing apps for patient mental state detection, user interfaces, or other relevant applications.[4]

III. METHODOLOGY

The FACE FEEL AI system's procedure includes image-based emotion recognition through an Android application. Firstly, the facial emotion dataset is designed, training an image learning model with Teachable Machine for diverse emotion expressions. The engineered model is exported to the Android application. The system enables users to enter the image either through taking a real-time image through the mobile camera or by browsing through the gallery pictures of the device. The input image is then processed through various techniques such as resizing and face alignment, among others, to optimise the accuracy of the result. The output image is then processed through the developed machine learning model to predict the linked emotion. Finally, the detected emotion is shown on the user interface in real-time. The entire process is optimized to ensure a fast execution, low resource utilisation, and efficient functionality on Android devices, which makes this system optimised for practical use.

3.1 PROBLEM STATEMENT

Real-time emotion detection has its applications in diverse fields of mental health analysis, human computer interaction, smart education, and user experience analysis. Not with standing, traditional emotion detection techniques are basically performed by human observation, questionnaires, and rule-based analysis of facial expressions. The aforementioned techniques are based on human intervention, resulting in time-consuming analysis of user emotions with a lack of accuracy of natural forms of expressions of user emotions. There are situations where traditional emotion detection techniques require special hardware at work, human intervention, and controlled environments, leading to the suitability of emotion detection being inappropriate for mobile emotion detection applications. Additionally, traditional emotion detection techniques are non-scalable for diverse conditions of lighting environments, face orientations, and picture qualities of images portraying facial expressions of users. The absence of effective, portable, and user-friendly emotion detection tools has slowed the development of emotion detection applications.

3.2 Objective

- To design and develop an Android-based application that classifies human facial emotions accurately using image learning models.
- To implement emotion detection through images captured in real time using the mobile camera or selected from the device gallery.
- To utilise image-based deep learning models (trained using Teachable Machine) for efficient and reliable facial emotion recognition.
- To provide a simple and interactive user interface that allows users to easily capture, upload, and analyse facial images for emotion results.
- To ensure fast and lightweight emotion classification suitable for real-time execution on Android devices with minimal computational overhead.

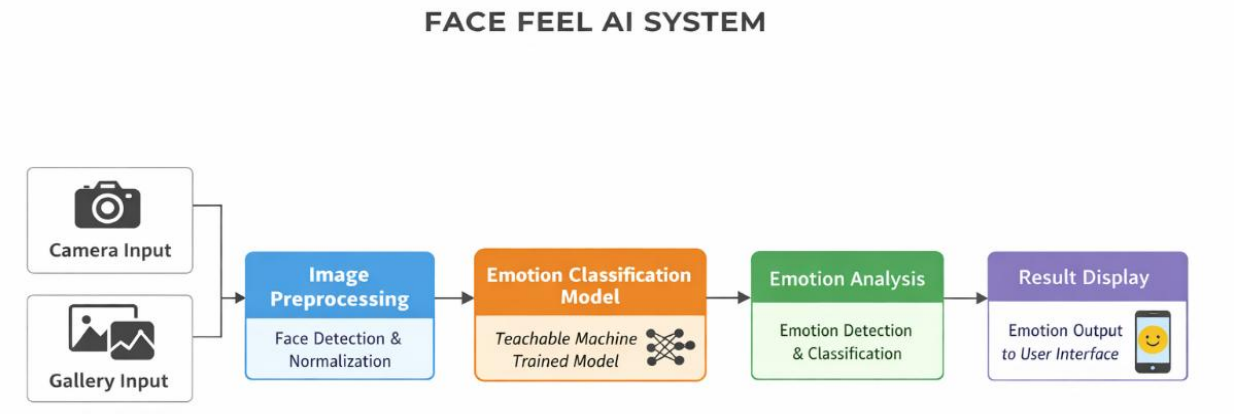
3.3 Proposed system

The proposed system, FACE FEEL AI, is an Android-based real-time emotion classification system that detects human emotions from facial images using image learning models. The system allows users to capture facial images through the mobile camera or select existing images from the device gallery. These images are then pre-processed to enhance quality and normalise facial features for accurate analysis. A machine learning model trained using Teachable Machine is integrated into the Android application. The trained model learns facial patterns corresponding to different emotional states such as happiness, sadness, anger, surprise, and neutrality. Once an image is provided, the system analyses facial expressions and classifies the detected emotion in real time. The application is designed with a simple and interactive user interface, enabling easy navigation and instant display of emotion results. The system is lightweight and optimized for mobile devices, ensuring fast processing with minimal computational overhead. By eliminating the need for specialized hardware and manual analysis, the proposed system provides an efficient, portable, and scalable solution for emotion

detection. This system can be effectively used in applications related to mental health monitoring, smart learning environments, and human–computer interaction.

3.5 Proposed system with advantages

- Accurately identifies facial emotions in real time using images from the mobile camera or gallery.
- Designed for simplicity and ease of use, allowing anyone, even non-technical users, to analyse emotions effortlessly.
- Operates efficiently on standard Android smartphones without the need for additional hardware.
- Uses lightweight image learning models to deliver fast processing while minimizing memory and power consumption.



IV. RESULT ANALYSIS

FACE FEEL AI: Emotion Classification System is shown to perform well in real-time facial recognition of emotions in Android devices. Experiments were conducted using the images taken through the camera in the mobile devices as well as through the gallery in the mobile devices. It is shown that the application is efficient in recognizing the facial emotions such as happiness, sadness, anger, surprise, and neutral faces correctly. Image preprocessing, encompassing face detection and face normalization, is an important component of the proposed system. Since it optimizes the input quality of the learning model, the image learning model based on Teachable Machine increases the efficiency of emotion classification with reduced delay. Therefore, it proves the system is appropriately designed for a real-time system. The results of the emotions are displayed on the user interface immediately and clearly. This makes the results easier to interpret. The system is robust and can handle varied orientations and expressions of the face. In addition to that, the design of the system is lightweight. This makes the app suitable to be run continuously on an Android phone. the findings from the experimental work reveal that FACE FEEL AI performs significantly well with respect to precision, quicker response time, and usability compared to the classical techniques for emotion recognition available today. It is evident that the project goal has been successfully addressed through the provision of a quick, automated, and easy-to-use system for FER using the created technology.

V. CONCLUSION

In conclusion, the FACE FEEL AI Emotion Classification Android System is a vast improvement in emotion recognition technology because of its intelligence, timeliness, an automation. The proposed system is able to focus on human emotion using image learning techniques. Unlike other systems, human observation, surveys, or reasoning approaches, the proposed system is able to detect human emotion based on a facial image. Thus, this approach is completely automated. One of the key strengths of the proposed system is its ability to operate in real-time on a mobile platform. The proposed system, with its ability to incorporate a Teachable Machine-trained model in an Android app, facilitates emotion recognition on a mobile platform from the camera as well as from gallery photos in real-time, not requiring

a specific setup with minimal computational power requirements in a real-time system. The proposed system's lightness enables faster processing with lower consumption than the existing system, which consumes more computational power in its execution. The user-friendly interface is an added advantage to the system, as it allows users to capture or upload images easily, getting instant results of emotional classification.

VI. FUTURE ENHANCEMENT

The FACE FEEL AI model can be further improved to increase accuracy, functionality, and the field of application. Future considerations can include the incorporation of more sophisticated AI models like Convolutional Neural Network (CNN) and transfer learning to increase the accuracy of emotion recognition. The model can be further improved to track emotions in videos in real-time instead of analysing emotions in a single image only. Inclusion of multi-emotion and micro-expression recognition can further enable sophisticated emotional analysis. Connection with cloud computing can further enable the processing of large amounts of data. The application can further be improved by incorporating emotion-driven suggestions for mental health assistance, learning, and interaction feedback. Inclusion of multi-lingual interfaces and functionality in low-light conditions can further make the application more user-friendly and accessible.

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