Tracking and detecting depression level using facial recognition and EQ test

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Abstract: Depression is a serious, pervasive mental issue in our general public. A large portion of the populace experiences this issue. Thus there is an outrageous requirement for the depression detection models, which will offer a helpful framework and early identification of depression. There is an essential need for relevant data to set up a depression detection model. This paper presents a brief summarization regarding ten depression datasets available, which will guide the researchers to select an appropriate dataset for their depression detection models. This summarization has been done over the non-verbal signs of depression, data collection techniques, clinical definition, and annotations. Moreover, a tabular list of datasets is provided for quick and easy look through.

These Human facial expressions convey a lot of information visually rather than articulately. Facial expression recognition plays a crucial role in the area of human-machine interaction. Automatic facial expression recognition system has many applications including, but not limited to, human behaviour understanding, detection of mental disorders, and synthetic human expressions. Recognition of facial expression by computer with high recognition rate is still a challenging task.

Two popular methods utilized mostly in the literature for the automatic FER systems are based on geometry and appearance. Facial Expression Recognition usually performed in four-stages consisting of preprocessing, face detection, feature extraction, and expression classification. The human face is an important part of an individual's body and plays an important role in knowing the individual's mood. The face is where a human expresses all his basic emotions. In the existing system, they examine the mental state manually by assessing them but have many disadvantages like we cannot predict any accurate solutions based on the assessment score because we might be not sure what kind of emotions the human user would be all time. To overcome this problem, a novel system is proposed to suggest an effective solution for predicting the mental state dynamically, we propose a hybrid architecture invoking facial based emotion sequence, PEN test and IQ test. By consistent monitoring of a human's emotion and subjecting to PEN and IQ tests, the human's mental state is routed. Combination of the above three techniques provides promising results for mental state and self-control.

Keywords: Depression Level, Conventional Neural Network, classification, algorithms, artificial intelligence, Machine Learning

I. INTRODUCTION

Facial expressions can be considered not only as the most natural form of displaying human emotions but also as a key non-verbal communication technique. The processing of emotional facial expressions is modulated by personality; for example, neuroticism, a dimension of the five-factor model of personality has been found to play a role in this regard. Neuroticism is characterized by the tendency to be anxious, nervous, and hostile. Neuroticism is also considered to be a risk predictor for depression. Dementia, attention deficit hyperactivity disorder, schizophrenia and obsessivecompulsive disorder. In schizophrenia, cognitive impairments are often found in multiple areas, including visual information processing; attention; working memory; short-term memory and learning; executive functioning; speed of processing; reasoning and problem solving; context processing and social perception and cognition.

The impairment of executive functions called "dysexecutive syndrome", are common in neurological patients and are related to brain dysfunction specifically in the prefrontal cortex. Individuals who have an impairment of executive functions shows problems of starting and stopping activities, a difficulty I mental and behavioural shifts,

an increased destructibility and difficulties in learning new tasks. The executive functions, defined as higher order cognitive functions needed for performing complex tasks, are often impaired also in patients with Obsessive Compulsive Disorder (OCD) which are characterized by the impairment of several skills such as attention, planning, problem- solving and behavioural control. No single profile of cognitive deficits has been found to characterize all patients. The majority have impaired ability in at least one area of functioning and a standardized platform for assessing neurocognitive functioning is an important aspect of comprehensive treatment and research for this and other conditions. In this world, lot of people are facing numerous problems which result in depression and mental illness and the users are motivated to innovate a solution integrating image processing and machine learning techniques to predict the mental illness by recognizing people's emotions and by conducting IQ and PEN tests to measure the mental illness and provide relevant suggestions

II. LITERATURE REVIEW

Depression is a common mental health issue affecting individuals across various age groups. Researchers have been using machine learning models to detect depression through audio, visual, and text data. Recent studies have focused on facial expression recognition (FER) and social media analysis to identify signs of depression. FER systems use techniques like Histogram of Oriented Gradients (HOG), Local Binary Patterns (LBP), and Convolutional Neural Networks (CNN) for accurate emotion detection. Meanwhile, social media activity, including text sentiment analysis and behavioral patterns, has been used to detect early signs of depression through models like LSTM classifiers and Multi-Aspect Depression Detection with Hierarchical Attention Networks (MDHAN).

Several studies have explored work-related mental health issues, emphasizing that workplace stress can contribute to mood disorders and anxiety. Machine learning models trained on survey data can predict employees' mental health status based on personal and professional factors. Researchers have also analyzed social networking behaviors, identifying psychological disorders such as cyber-relationship addiction and information overload. Feature extraction and classification models like Random Forest and Support Vector Machines (SVM) have been used to detect mental health issues based on online activities. In addition, researchers have studied mobile health applications that integrate psychological measures like the DASS-21 scale for early depression detection, aiming to improve usability and treatment outcomes.

Model explainability is crucial in medical applications to enhance trust and reliability. Many deep learning models lack interpretability, making them difficult to apply in real-world scenarios. To address this, researchers have proposed hierarchical attention networks that analyze user-generated text from platforms like Reddit and Twitter, identifying depression-related language patterns. EEG studies have also been conducted to examine neural responses to facial expressions, further contributing to emotion recognition research. These advancements in AI-driven depression detection provide valuable tools for early intervention and mental health support.

III. SYSTEM ARCHITECTURE

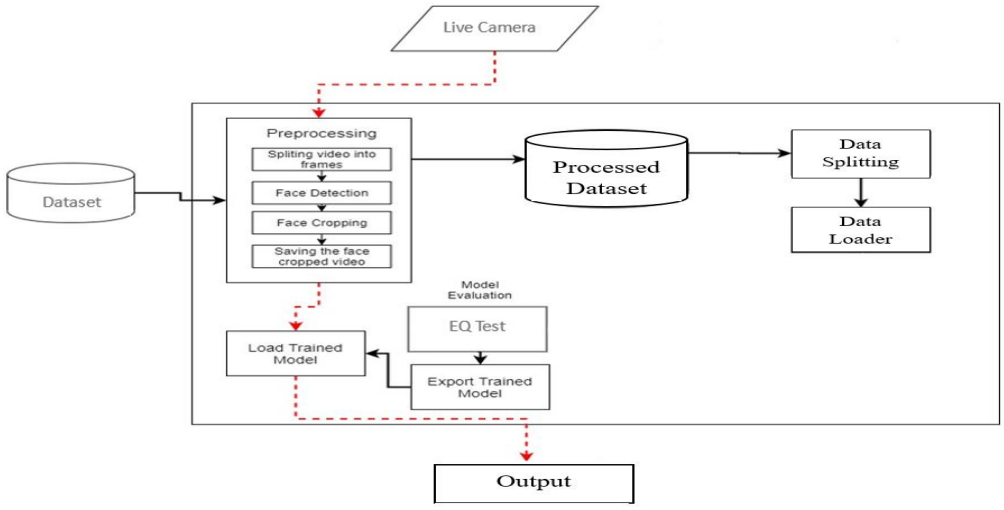

Fig.1 System Architecture of Depression Detection Using Facial Recognition and EQ Test

This diagram outlines a system that assesses a person's depression level using facial emotion detection and an emotional intelligence (EQ) test. First, a live image of the person is captured, and face detection is applied to isolate the face for analysis. The individual also takes an EQ test, providing more data about their emotional state. Key features are then extracted from both the facial image and the EQ test. A Convolutional Neural Network (CNN) classifier analyzes the features to detect the person's emotional state. Based on this, the system quantifies the level of emotion, displaying the depression level if applicable. If depression is detected, the system provides suggestions or advice for the person.

IV. METHODOLOGY

To develop an automated system for detecting face swap-based deepfake videos, we followed a structured methodology to ensure high detection accuracy and robustness. The approach focused on leveraging advanced machine learning techniques to differentiate between real and manipulated content. Below is a detailed description of the methodology:

A. Data Collection and Preprocessing

The first step involves collecting and preparing the necessary datasets, ensuring a diverse and representative sample for effective depression detection.

Steps in data collection and processing:

1. **Facial Data Collection**
   - i. Dataset Sources: We collect facial image and video data from publicly available datasets, such as AffectNet, DAiSEE, and private clinical datasets with appropriate consent.
   - ii. Real-Time Data Acquisition: The system captures real-time facial expressions using a webcam or mobile camera for continuous monitoring.

2. **EQ Test Data Collection**
   - i. Psychological Questionnaire: Users answer a standardized EQ test, incorporating scientifically validated questions related to emotional well-being and mood assessment.
   - ii. Scoring Mechanism: Each response is assigned a score based on predefined psychological models to assess emotional states and cognitive well-being.

3. **Data Preprocessing**
   - i. Face Detection and Alignment:Facial recognition algorithms (e.g., OpenCV, MTCNN) detect faces and align them to a standardized position.
   - ii. Feature Extraction:Key facial features such as eye movement, mouth curvature, and overall facial muscle activity are extracted using deep learning models like CNNs.
   - iii. Data Augmentation:Techniques like brightness adjustment, flipping, and rotation are applied to enhance the dataset's robustness and improve generalization.

B. Model Design

The depression detection model combines facial expression analysis and EQ test results using deep learning and machine learning techniques.

Components of the model:

1. **Facial Expression Analysis**
   - i. CNN-based Feature Extraction:Convolutional Neural Networks (CNNs) analyze spatial features from facial images, identifying patterns associated with depression.
   - ii. Recurrent Neural Networks (RNNs) with LSTM:Long Short-Term Memory (LSTM) networks track temporal changes in facial expressions to observe fluctuations in emotional states.

iii. Attention Mechanism:Focuses on critical facial regions, such as the eyes and mouth, where depression-related expressions manifest prominently.

2. EQ Test Integration

i. Machine Learning Classification:Decision trees, support vector machines (SVM), or Random Forest algorithms classify EQ test scores into different depression levels.

ii. Feature Fusion:A weighted combination of facial expression analysis and EQ test results is used to enhance prediction accuracy.

C. Training and Validation

The dataset is divided into training, validation, and test sets to ensure model reliability and performance.

Steps in training and validation in model:

1. Training the Model

i. Hyperparameter Tuning:Learning rate, batch size, and number of epochs are optimized using grid search and random search techniques.

ii. Regularization Techniques:Dropout layers prevent overfitting and ensure model generalization.

2. Model Evaluation

i. Performance Metrics:Accuracy: Measures overall correct classifications.

ii. Precision and Recall: Evaluate true positive and false negative rates.

iii. F1-Score: Ensures a balance between precision and recall.

iv. ROC-AUC: Assesses model performance across various threshold settings.

3. Confusion Matrix Analysis:

i. Visualizes classification performance, distinguishing between mild, moderate, and severe depression levels.

D. Deployment and User Interaction

The trained model is integrated into a web-based platform, ensuring accessibility and ease of use for both individuals and mental health professionals.

1. Web Platform Features

i. User Authentication:Secure login and registration system to track individual assessments over time.

ii. Facial Expression Analysis:Users can upload images/videos or use live camera input for real-time depression level assessment.

iii. EQ Test Interface:An interactive questionnaire with automated scoring and result interpretation.

2. Depression Level Detection Output

i. Detailed Report:Classification of depression severity (normal, mild, moderate, severe) with an explanation of contributing factors.

ii. Visual Feedback:Heatmaps or facial emotion graphs highlighting detected expressions.

iii. Recommendations:Suggestions for mental health resources, therapy, or lifestyle adjustments.

E. Performance Optimization and Real-World Applications

To enhance the efficiency and usability of the system, various optimization strategies are implemented.

1. **Performance Optimization**
   - i. GPU Acceleration: Utilizes GPUs for faster model inference and video processing.
   - ii. Low Latency: Optimized algorithms ensure quick depression level predictions.

2. **Real-World Applications**
   - i. Clinical Support: Assists mental health professionals in early diagnosis and monitoring of depression.
   - ii. Workplace Well-being: Employers can use anonymized data to assess employee well-being and implement wellness programs.
   - iii. Personal Mental Health Tracking: Individuals can track their emotional health trends and seek timely intervention.

3. **Continuous Improvement**
   - i. Model Retraining: Regular updates with new data to improve accuracy and adapt to emerging patterns.
   - ii. User Feedback Integration: User input and clinical validation to refine model predictions.

V. RESULT AND DISCUSSION

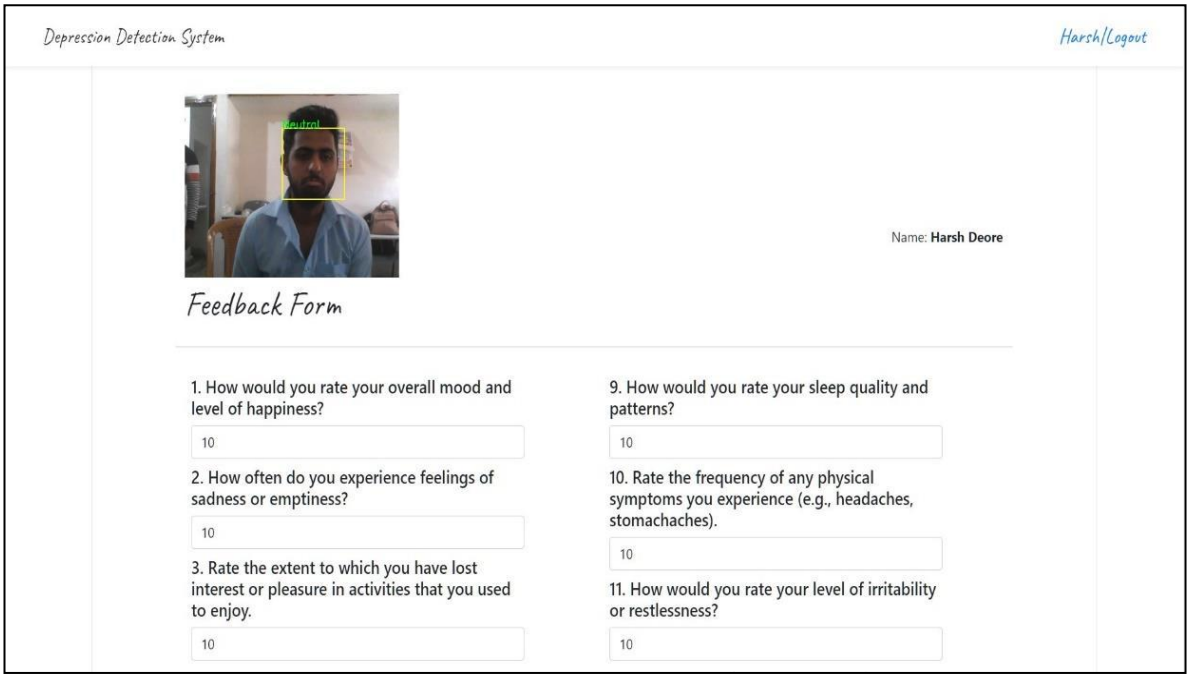

Fig 5.1 Facial recognition & EQ Test Page

Description: The Feedback Form Page of the Depression Detection System is designed to collect user responses for depression assessment. At the top, there is a live camera feed capturing the user's face, outlined with a green detection box, ensuring proper facial recognition. The user's name is displayed on the right side for personalization. Below, the form consists of multiple rating-based questions focusing on mood, emotions, sleep quality, physical symptoms, and overall well-being. Each question has a text box for input, where users can rate their experiences. The navigation bar at the top includes a logout option, allowing users to exit the system securely. The page provides a structured way to assess emotional and mental health based on user feedback and facial recognition.

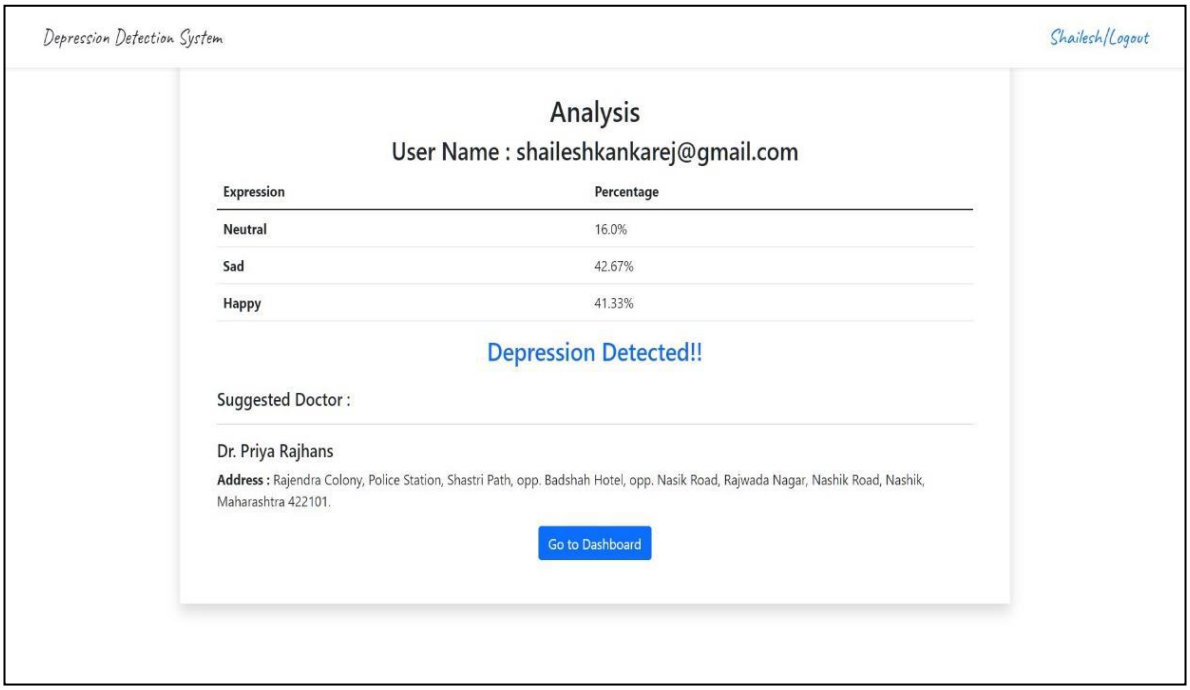

Fig 5.2 Depression Not Detected Result Page

Description: By combining facial recognition with EQ test analysis, this system provides an innovative and reliable approach to detecting and tracking depression levels, ultimately promoting mental health awareness and intervention.

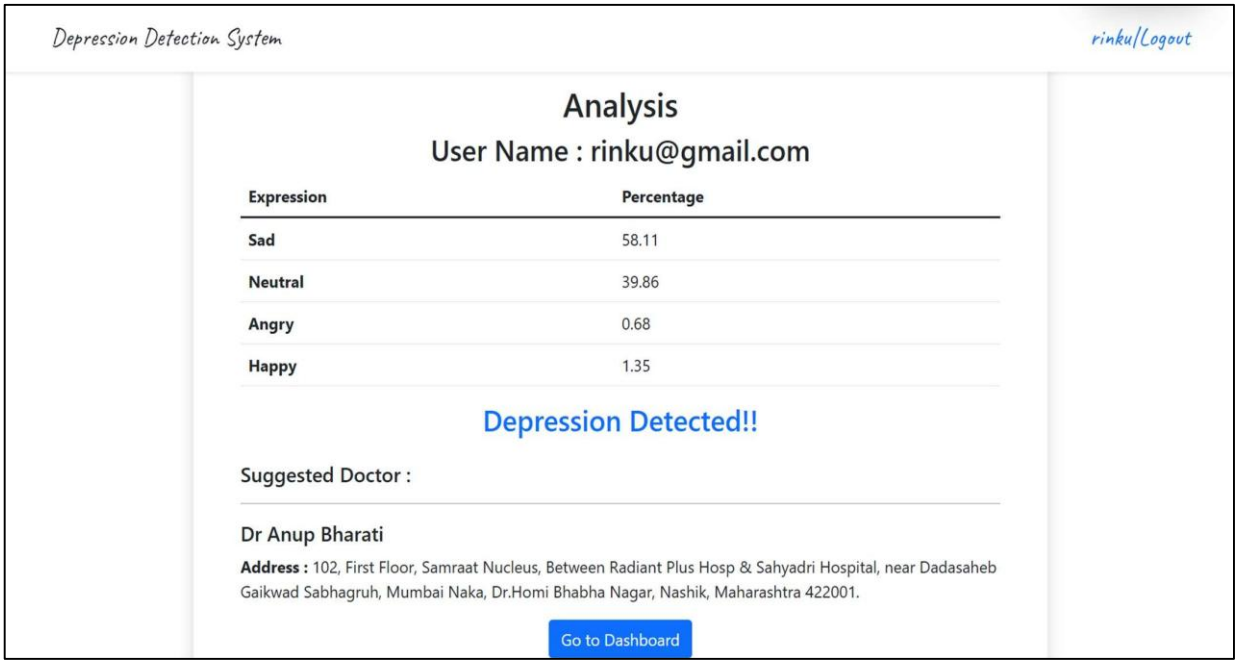

Fig 4.2. Depression Detected Result Page AI-Based Depression Detection System

Description: The front-end of the AI-powered Depression Detection System is designed with a user-friendly and intuitive interface. Users can easily upload a video or take a real-time facial scan through their device's camera. Additionally, they will complete an Emotional Quotient (EQ) test to provide further insights into their emotional state.

Once the facial recognition model processes the video and the EQ test is submitted, the system analyzes the results and displays the depression level on the screen. The result will indicate whether the user is experiencing no depression, mild depression, moderate depression, or severe depression based on the detected facial expressions

and EQ test scores.

How It Works

1. **Facial Recognition for Depression Detection:** The system uses computer vision and deep learning to scan the user's face, analyzing facial expressions, eye movement, and micro-expressions to detect signs of depression. AI models trained on large datasets of human emotions help in identifying these subtle changes.
2. **EQ Test Analysis:** The EQ test is a set of multiple-choice psychological questions designed to measure emotional intelligence, stress levels, and cognitive responses. The system evaluates the answers to detect signs of emotional distress.
3. **Spotting Emotional Patterns:** The system flags specific video frames where the user's expressions indicate sadness, anxiety, or emotional distress. In the EQ test, it highlights responses that suggest low emotional well-being or high stress levels.
4. **Detecting Depression Symptoms:** AI algorithms detect key depression indicators such as:
   i. Lack of eye contact (sign of social withdrawal)
   ii. Frequent frowning or sad expressions
   iii. Low facial movement or forced smiles
   iv. Slower response time in the EQ test

VI. CONCLUSION

In conclusion, tracking and detecting depression levels using facial recognition, EQ tests can be a valuable tool for early detection and intervention for individuals at risk of developing or already suffering from depression. The proposed system utilizes facial recognition technology to detect changes in facial expressions and mood, as well as EQ tests to analyze cognitive function. By integrating these technologies, the proposed system can provide a comprehensive assessment of an individual's mental state, allowing for early detection. this project has the potential to provide a cost-effective and efficient method for detecting and monitoring depression levels in individuals. This can lead to timely intervention and treatment, improving the quality of life of individuals suffering from depression.

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Keywords: Depression Level, Conventional Neural Network, classification, algorithms, artificial intelligence, Machine Learning

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libraries:

[9] OpenCV
[10] NLP
[11] numpy
[12] pandas

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