STRESS DETECTION USING MACHINE LEARNING

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Abstract - *The management of stress is essential in recognizing the levels of stress that can hinder our personal and social well-being. According to the World Health Organization, approximately one in four individuals experience stress-related psychological problems, leading to mental and socioeconomic issues, poor workplace relationships, and even suicide in severe cases. Counseling is a necessary resource to help individuals cope with stress. While stress cannot be entirely avoided, preventive measures can assist in managing stress levels. Currently, only medical and physiological experts can determine whether someone is experiencing stress or not. However, the traditional method of detecting stress based on self-reported answers from individuals is unreliable. Automating the detection of stress levels using physiological signals provides a more accurate and objective approach to minimizing health risks and promoting the welfare of society. The detection of stress levels is a significant social contribution that can enhance people's lifestyles. The IT industry has introduced new technologies and products that aid in the detection of stress levels in employees, which is critical in enhancing their performance. Although several organizations offer mental health schemes for their employees, the issue remains challenging to manage.*

Key Words: **Python, Machine Learning, Stress Detection, Haarcascade Algorithm, CNN(Convolutional Neural Netwrok) algorithm**

1. INTRODUCTION

Stress is an inevitable aspect of life that causes unpleasant emotional states, especially when individuals work long hours in front of computers. Therefore, monitoring the emotional status of people in such situations is crucial for their safety. A camera is positioned to capture a near frontal view of the person while they work in front of the computer, allowing for the man-machine interface to be more flexible and user-friendly. Human experts possess privileged knowledge regarding facial features that indicate ageing, such as smoothness, face structure, skin inflammation, lines, and under-eye bags, which is not available for automated age estimates. To address this issue, asymmetric data can be utilized to enhance the generalizability of the trained model. The proposed model aims to predict mood levels or activities based on scores with class labels, implement the test model using supervised learning, and achieve maximum accuracy in executing the proposed system. Overall, this research seeks to enhance the accuracy and reliability of stress and age detection systems to better serve society.

1.1 Problem Statement

Stress is a widespread issue that can have a negative impact on people's personal and professional lives. The current methods of detecting stress based on self-reported answers are subjective and unreliable, which calls for the need for a more accurate and objective approach. Automated detection using physiological signals, particularly heart rate variability, has been proposed as a potential solution, but it is essential to evaluate the effectiveness of these systems in real-world settings to ensure their practicality and reliability. Furthermore, exploring novel technologies like computer vision could improve the accuracy and generalizability of stress detection systems. Therefore, the problem statement of this report is to investigate how automated physiological and computer vision-based approaches can effectively detect stress levels in real-world settings and explore ways to enhance their accuracy and generalizability.

1.2 Literature Survey

1.2.1 A novel depression detection method based on pervasive EEG and EEG splitting criterion

Depression is a mental health disorder characterized by persistent low mood states, and it is expected to become the second largest cause of illness worldwide in 2020, according to the World Health Organization. Early detection, diagnosis, and treatment of depression are critical to saving lives and preserving health. Therefore, there is a pressing need for a portable and accurate method for detecting and diagnosing depression. However, the highly complex, non-linear, and non-stationary nature of electroencephalogram (EEG) data presents a challenge for developing effective depression detection methods. In this paper, a novel approach is proposed for pervasive EEG-based detection and diagnosis of depression using resting-state eye-closed EEG data collected from Fp1, Fpz, and Fp2 locations of scalp electrodes through a three-electrode pervasive EEG collection device. The study collected EEG data from 170 participants (81 depressive patients and 89 normal subjects) and used Support Vector Machine (SVM) analysis to analyze the data. The average accuracy of the method was found to be 83.07%, demonstrating its effectiveness in detecting and diagnosing depression. Furthermore, the study suggests that the three-electrode pervasive EEG collection device has potential for use in depression detection and diagnosis.

1.2.2 Multi-Modal Depression Detection and Estimation

Depression and anxiety are significant mental health concerns in modern society, with the World Health Organization reporting that about 12.8% of the global population suffers from depression. In this study, we propose innovative approaches to multi-modal depression detection and estimation. In our previous research, we explored multi-modal features and fusion strategies, and the hybrid depression classification and estimation multi-modal fusion framework showed promising performance. The current study consists of two parts: To address the issue of insufficient data for training depression deep models, we utilize Generative Adversarial Network (GAN) to augment depression audio features, enhancing depression severity estimation performance. We introduce a novel FACS3DNet that combines 3D and 2D convolution networks for facial Action Unit (AU) detection. To our knowledge, this is the first study that applies 3D CNN to AU detection. Our future research will focus on combining depression estimation with dimensional affective analysis through the proposed FACS3DNet, as well as collecting a Chinese depression database. These studies will be part of the author's dissertation. Our research primarily focuses on three areas: (1) investigating effective multi-modal features and fusion strategies for depression recognition; (2) mitigating the impact of insufficient data on training depression deep models; and (3) integrating depression estimation with dimensional affective analysis. In terms of the first point, we found that when depression classification and estimation are considered together, superior performance can be achieved. Language information, such as text features, can effectively classify depression, while audio and video can construct a preliminary depression estimation framework. For the second point, the DCGAN-based data generation approach significantly improves depression estimation performance and provides new insights into depression data augmentation. Additionally, we have begun collecting a Chinese depression database. As for the third point, which is our future work, we will utilize the FACS3D-Net to simultaneously integrate depression estimation with dimensional affective analysis. We believe that this research will offer a unique perspective on depression recognition..

1.2.3 Quantification of depression disorder using EEG signal

Depression is a prevalent psychological disorder that has become a growing concern in the field of science. To determine the level of depression in individuals, mental health questionnaires like Beck's questionnaire assign a numerical indicator. Recent studies have revealed that the level of depression is linked to structural changes in the brain, which means it is possible to detect the level of depression by analyzing brain signals. This paper proposes a new method for estimating the Beck's index of each subject by extracting specific features from the patient's EEG signal. The proposed algorithm utilizes a combination of a fuzzy classifier and support vector machine (SVM) to quantify depression. The results of the experiment show that the designed system has a good ability to determine the numerical index for depression, with a percent relative difference (PRD) of 5% and a Pearson correlation of 0.92. These results suggest that the estimated numerical value of the proposed system is highly correlated and has a low amount of PRD when compared to the original Beck number assigned to each person.

1.2.4 Prediction of Depression from EEG signal using Short term memory(LSTM)

Depression is a neurological disorder that has become a major global concern. EEG recordings have proven to be effective in diagnosing and analyzing various neurological disorders, including depression. In this study, a deep learning model based on LSTM (Long Short-Term Memory) is used to predict depression trends for future time instants based on extracted features. . The model uses a single LSTM layer with ten hidden neurons for prediction. The model is trained using 5600 out of a total of 7000 mean values obtained from a sample of 30 patient records. The LSTM network successfully predicted the next 1400 sample mean values with a root mean square error of 0.000064. The model's performance is compared with ConvLSTM and CNNLSTM, and it is concluded that the LSTM predictor model is the most effective for predicting depression trends..

2. Proposed System

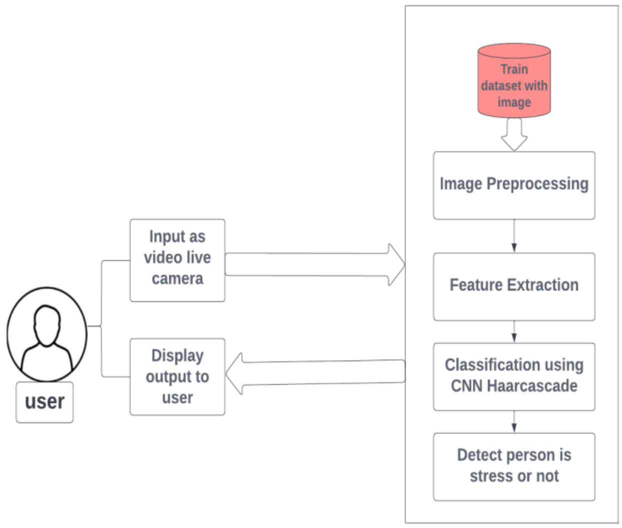


Fig -1.3.1: **System Architecture**

The purpose of this proposed system is to detect stress based on the CNN algorithm and Haar cascade algorithm using machine learning model. The system will use a camera to analyze facial expressions and detect stress. The system will provide users with a stress level result in terms of percentage value, along with recorded facial expressions stored in database to help users understand their stress triggers and take necessary measures.

System Architecture:

The proposed system architecture includes the following components:

1. Camera: A live camera will capture the facial expressions of the user.

2. Preprocessing: Preprocessing involves cleaning and transforming raw data into a format that is suitable for analysis. In the proposed system, preprocessing will involve tasks such as removing noise from images, correcting image orientation, scaling images to a consistent size, and converting images to grayscale.

3. Feature extraction: Feature extraction involves identifying and extracting relevant information (features) from the preprocessed data. In the proposed system, feature extraction will involve tasks such as identifying shape or structural features from images, extracting color features, or identifying texture features. These extracted features can then be used as inputs for further analysis, such as classification or clustering.

4. CNN Algorithm: The CNN algorithm will analyze images after feature extraction and classify them.

5. Haar Cascade Algorithm: The Haar cascade algorithm will detect facial features and patterns.

6. Stress Detection System: The stress detection system will determine the stress level of the user in percentage and provide the most recorded expression like happy, sad or neutral.

7. User Interface: The user interface will display the stress level result and average of recorded facial expressions.

Working:

The live camera of the device will capture the facial expressions of the user, which will be preprocessed and then undergo feature extraction. The CNN algorithm will recognize facial features and patterns to detect stress. The Haar cascade algorithm will analyze facial expressions to detect stress-related patterns. The stress detection system will integrate the results of both algorithms to determine the user's stress level. The user interface will display the stress level result, along with recorded facial expressions. The recorded facial expressions will help users understand their stress triggers and take necessary measures.

3. Algorithm:

3.1 Convolutional Neural Network (CNN):

The CNN algorithm, or Convolutional Neural Network algorithm, is a type of deep learning algorithm used in computer vision and image processing. It uses filters or kernels to extract features from images by performing convolution operations. These features are then passed through a series of layers, including pooling and activation layers, to create a feature map. The feature map is then flattened into a vector and passed through fully connected layers to make predictions about the image. CNNs are used in many applications, such as object detection, facial recognition, and medical imaging. CNN (Convolutional Neural Network) can play a critical role in object detection and image classification tasks in the proposed system, particularly in computer vision applications. CNNs are known to be highly effective in recognizing visual patterns in images and detecting objects with high accuracy. They can extract relevant features from images and classify them into different categories, making them useful in applications such as facial recognition, object detection, and autonomous vehicles.

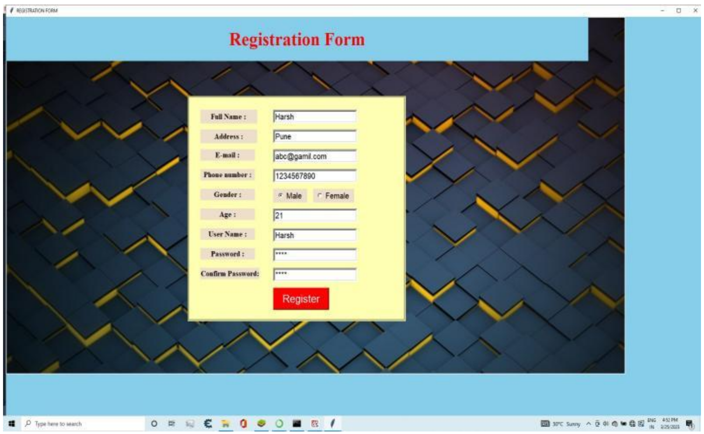
3.2 Haar cascade Algorithm:

Haar cascade algorithm is a machine learning-based object detection algorithm used to detect objects in images or videos. It uses a set of pre-trained classifiers to identify features of an object, such as edges, curves, and corners. The algorithm then uses these features to scan the image or video to detect the presence of the object. The Haar cascade algorithm is based on the idea that an object can be detected by looking for specific features in its lighter and darker areas. It uses a cascade of classifiers to detect the object at multiple scales and orientations. The Haar cascade algorithm plays a crucial role in the above proposed system as it is used for object detection and recognition. The algorithm utilizes the concept of feature extraction and machine learning to identify and detect specific objects of interest. In the proposed system, the Haar cascade algorithm is used to detect and recognize faces. Since the algorithm is computationally intensive, it uses the integral image method to speed up the calculations. This reduces the algorithm's processing time, making real-time object detection possible.

4. RESULTS

LOGIN PAGE

REGISTRATION PAGE



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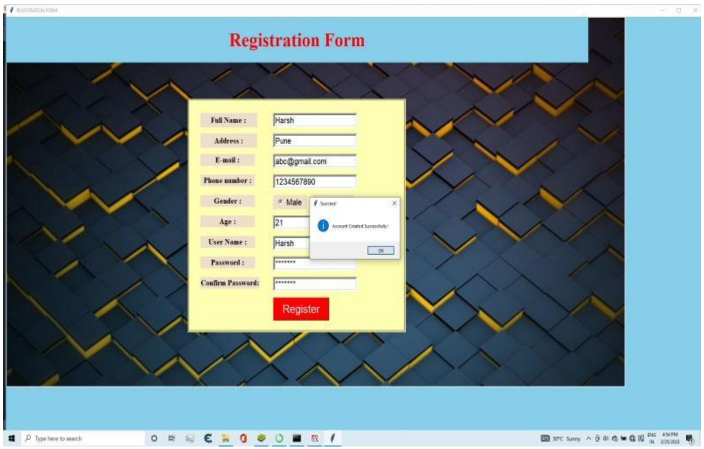
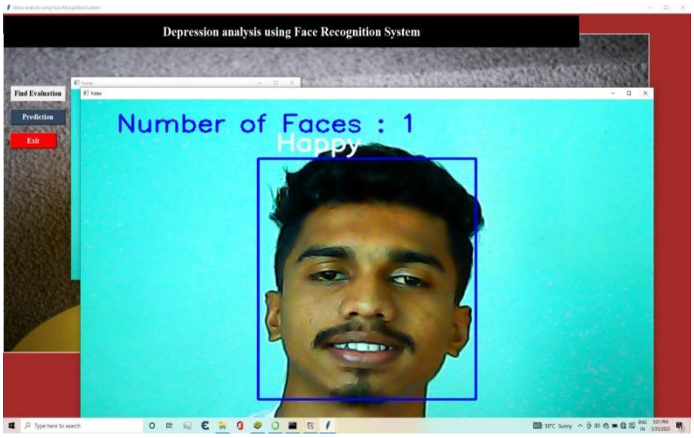


MAIN PAGE

FACE EVALUATION PAGE



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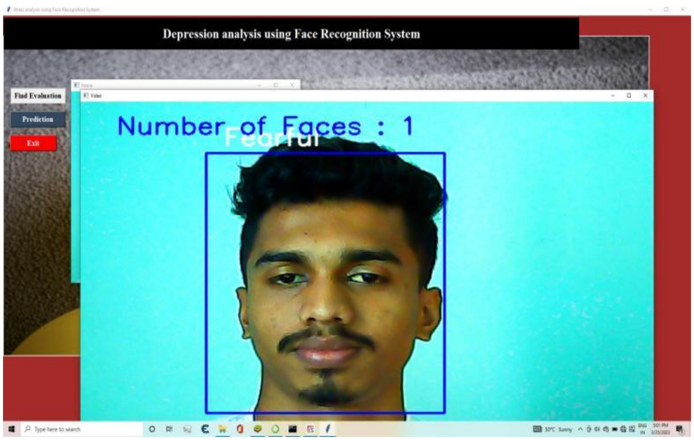

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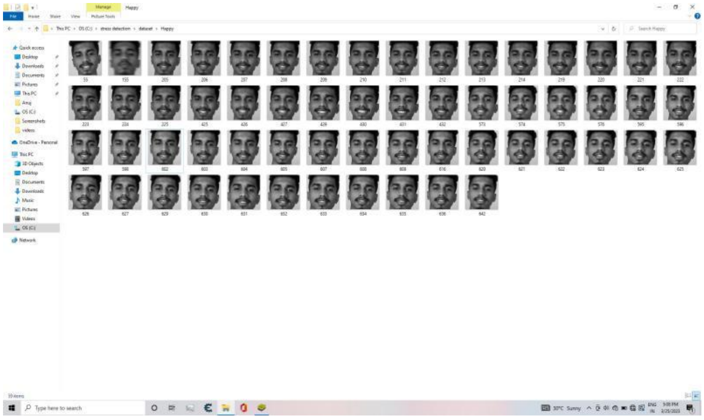

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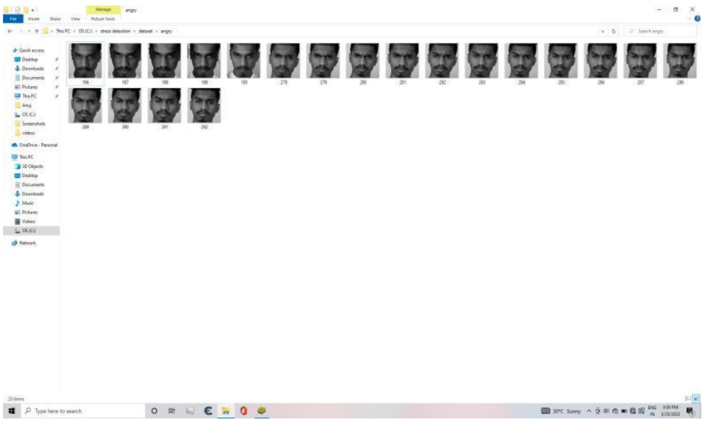
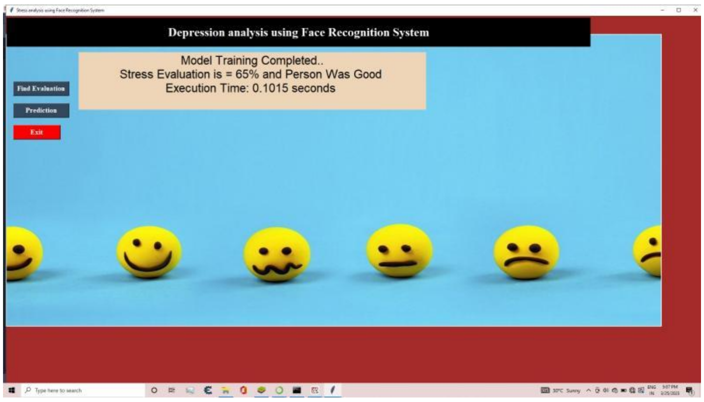


PREDICTION PAGE



3.FUTURE SCOPE

Future work on the study will focus on creating a system that can analyse Future work on the study will focus on creating a system that can analyse a tweet's discussion topic in addition to detecting stress. As a survey system, this might work. On every contentious issue, it would offer a better resolution and reveal the general consensus in fields like politics and the press.

4. CONCLUSION

Our proposed system aims to determine whether an individual is experiencing stress or not, with the results presented in percentage format. The primary objective of this system is to raise awareness about mental health and to encourage individuals to effectively manage or reduce stress levels during extended work sessions. By providing real-time updates and alerts, this system will enable individuals to take proactive measures to maintain their well-being and prevent the negative impact of stress on their physical and mental health.

5. ACKNOWLEGEMENT

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