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STRESS AND EMOTION DETECTION USING MOBILENET

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Abstract

Stress has become a prevalent aspect of daily life, affecting individuals of all ages and requiring them to cope with it. The impact of stress can extend to both mental and physical well-being, contributing to issues such as depression, hypertension, cardiovascular disease, and a compromised immune system. Identifying stress at an earlier stage can help prevent numerous health problems. The project aims to collect people's images and analyze them using the approach of using MobileNet model to detect stress. The MobileNet model is a type of CNN model that uses a depth-wise separable convolutional layer. This approach uses a dataset of facial images with different stress levels to train the model, which learns to identify and classify patterns in the images associated with stress. Based on the type of emotion, the model divides stress into six categories and labels it as no stress if no tension is present. The study's general strategy is to recommend a detection system that is trustworthy, practical, and precise. Its precise goals are to predict stress in an individual determined by using photos and video capture and to provide suggested activities.

Keywords

Stress detection, Emotion detection, Deep Learning,MobileNet model, Convolutional Neural Network (CNN).

1. Introduction

Stress and anxiety are two emotional states that have a big impact on a person's quality of life. People experience diverse effects of stress, a common psychological condition. Two types of stress exist, namely Short-term and Long-term, the latter also referred to as chronic stress. Short-term stress is situational and dissipates once the situation changes. In contrast, chronic stress is an enduring problem that can be hazardous. Additionally, chronic stress may be partially influenced by genetic factors or hereditary traits [1]. Health care, psychology, and human-computer interaction are just a few of the areas where real-time monitoring and detection of stress can be very helpful [2].

Facial expressions can be used as accurate markers of stress; therefore, this is one method of identifying it. The emotional state of a person can be inferred from their facial expressions [3]. Hence, a CNN-based MobileNet algorithm for stress classification based on facial photos may be a useful tool for stress monitoring. A deep learning model created specifically for mobile and embedded devices, the MobileNet algorithm. It is a form of CNN designed with low-power, low-latency devices in mind.

A sizable dataset of tagged facial photographs, including both stressed and non-stressed facial expressions, is used to train the stress classification algorithm. Using information gleaned from the images through convolutional layers, the system learns to correctly categorize each image as stressful or non-stressed. After training, the model may be used to categorize fresh facial photos and assign a stress categorization label.

The next part of the paper is followed by a literature review in section 2, the methodology in section 3, results in section 4, and the conclusion and future enhancements in the last section.

2. Literature Review

E. Padma et al, [4] The proposed approach employs machine learning methods, such as KNN classifiers, to categorize stress. Image processing is used as the first phase of the detection procedure, with the employee's picture coming through the browser as input. By translating an image to digital form and performing operations on it, image processing can be used to enhance an image or extract important information from it. By utilizing an image as an input and generating an image or characteristics that are linked to the image as an output. The feelings are depicted on the rounder box. Stress markers include feeling angry, disgusted, scared, and depressed.

Anupriya et al, [5] Employ facial expressions to gauge someone's degree of tension and determine whether stress is recognized based on comparisons and outcomes. Based on the CNN model, which was trained to utilize datasets and methods of image processing, the person's stress level is determined from the acquired images.

Kakoli Banerjee et al, [6] Devices like EEG, PPG, and GSR are used to record data from various physiological signals. Stress is identified using a genetic algorithm and categorized using an enhanced CNN with an LSTM classifier. Using EEG, GSR, and PPG sensor devices, it was determined to help anticipate the human being's calm and stressed stages based on their feelings.

Prof. Vishal R. Shinde et al, [7] Using the KNN classifier to analyze facial expressions, a method for detecting stress is developed. The technology operates when the IT expert is seated in front of the camera; at that point, it can recognize the facial expression and function in real time. The employee is working in front of the computer, while a camera records his near-front perspective. The recorded video is split into equal-length segments, and an equal number of visual frames are taken and inspected from each segment. The integrated choice of individual frames ultimately determines the level of tension involved.

4. Methodology

Stress is a common occurrence that impacts people in diverse ways. Various factors such as work-related problems, financial worries, relationship issues, and health concerns can trigger stress. Although moderate stress can be advantageous and inspiring, excessive, or long-term stress can have harmful effects on a person's health, causing symptoms such as tiredness, nervousness, despondency, and even physical disorders. It is crucial to learn how to manage and alleviate stress to promote overall well-being and enhance the quality of life. Using facial expressions as indicators is a reliable method for identifying stress. The reason is that emotional state can be deduced by analyzing a person's facial expressions.

MobileNet is a type of Convolutional Neural Network (CNN) that is utilized for image

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classification purposes. Its primary focus is on being used on mobile devices that have limited computational resources. Although MobileNet's resource needs are minimal, it can still achieve a high level of precision in classifying images [8].

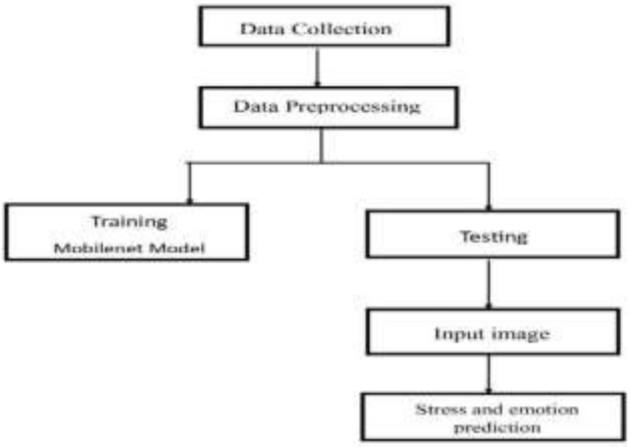
A dataset of facial images, which was accessible to the public on Kaggle's website, was employed to train the model. Make sure that the dataset consists of a suitable number of accurately labelled stressed and non-stressed images. Data preprocessing involves taking necessary actions to prepare and cleanse data so that it can be effectively analyzed or modelled.

During data preprocessing, resizing the images in the dataset may be necessary to maintain consistency and decrease the computational load during analysis. Additionally normalizing the pixel values of the images can be beneficial in reducing the impact of lighting and contrast discrepancies to make the images more suitable for analysis. Techniques such as image augmentation, including rotation, flipping, and cropping, may be applied to diversify and enlarge the dataset, leading to better model generalization on new images.

Two sets have been created from the dataset; one for training the model and the other for testing it. We are using the MobileNet algorithm to train our model with the pre-processed training dataset. This algorithm comprises four layers: the Input layer, Convolution Layer, Pooling layer, Flatten layer, and Dense layer [9]. The Input layer accepts the input images, while the Convolution Layer converts the image into a matrix format of size 1024 X 1024 (rows X columns). The Pooling layer stores the numerical values, and we apply the supervised learning algorithm Softmax to convert the numerical data into binary data. The Softmax layer transforms the numerical data into binary format. The softmax function equation (1) is given:

$$Softmax(z_j) = \frac{\sum e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \quad \text{..............................(1)}$$

The number of classes is represented by K, and zj is the value of the jth vector. As we can see, the denominator normalizes the result to a value between 0 and 1, while the exponential function smooths the output value.



The Flatten and Dense layers contain the classes for the entire dataset, which consists of seven types, stored in binary format. We use the fit generator method to save the data in .h5 format, with the model serving as a structure for storing the binary data. The below fig 1. shows the flow diagram

Fig 1. Flow diagram

For testing, we upload the image that needs to be tested and provide it to the saved model to predict the output, such as "No Stress," "Sad-based stress," "Angry-based stress," "Fear-based stress," and "Disgust-based stress."

5. Results

The output screenshots shown in figs. 2,3,4 below, were created after the images were uploaded and were classified as fear-based stress, disgust-based stress, sad-based stress, anger-based stress, and no stress.

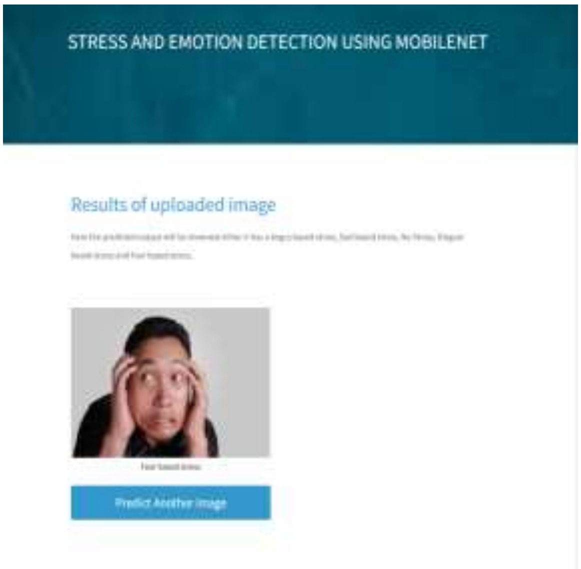


Fig 2. Output1 classified as Fear Based Stress

Fig 3.

Output 2 classified as Anger-Based Stress

Fig 4. Output 3 classified as No Stress

The output generated during a live prediction, which involves capturing a video through a webcam and predicting the type of stress a person is experiencing, is illustrated in Fig 5. below.

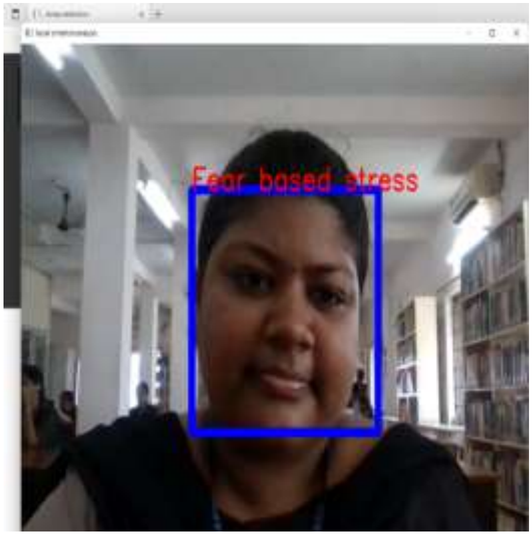


fig 5. Stress detection using live prediction

Evaluation metrics are utilized for gauging the effectiveness of a machine learning model or algorithm. They play a crucial role in determining the model's performance and

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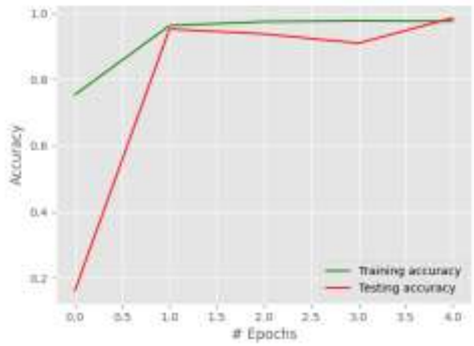
whether it meets the intended goals. Figs 6,7, and 8 show the graph of Performance measures like accuracy, precision, recall, and model loss used for evaluation. The model has



obtained an accuracy of 98%.

Fig 6. model accuracy

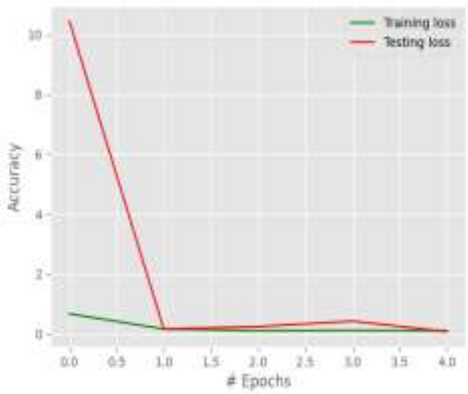


Fig 7. model loss

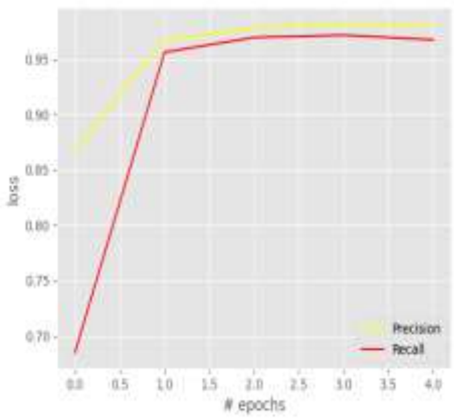


Fig 8. Precision and recall

Accuracy is a frequently employed measure of a machine learning model's performance that quantifies the percentage of correct predictions. The calculation involves dividing the total number of accurate predictions by the total number of predictions made by the model. A higher accuracy value signifies superior performance. The formula for accuracy is as follows.

$$\text{Accuracy} = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}} \quad \text{.........................(2)}$$

Precision represents the ratio of true positive predictions to all positive predictions made by the model, indicating the accuracy of positive predictions. Recall measures the proportion of true positive predictions out of all actual positive instances in the dataset, reflecting the ability of the model to identify positive instances correctly. The precision and recall can be calculated using the following equations (2), (3):

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives + False Positives}} \quad \text{.........................(3)}$$

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives + False Negatives}} \quad \text{.........................(4)}$$

6. Discussion

Stress detection using MobileNet, which is a type of Convolutional Neural Network (CNN), has emerged as a promising area of research.

MobileNet is a lightweight CNN architecture that has been designed for resource-constrained devices, such as smartphones or wearable devices, which have limited processing power and memory. Its architecture is optimized for speed and efficiency, which makes it well-suited for processing data in real time. MobileNet can be trained on large datasets, which can improve its accuracy over time. MobileNet is adaptable to different applications and contexts since its architecture can be fine-tuned to specific tasks and requirements. Researchers have utilized MobileNet to detect stress from facial expressions by analyzing the movements and changes in facial features, such as eye blinking, lip tightening, or forehead wrinkles [10]. Moreover, MobileNet has been used for multimodal stress detection, where data from multiple sources, such as facial expressions and physiological signals, are combined to improve the accuracy of stress detection. MobileNet-based multimodal approaches have shown promising results for stress detection in different scenarios, such as in the workplace or in mental health applications.

7. Conclusion

To sum up, the information suggests that researchers used a Mobilenet model to categorize stress based on facial images, resulting in a remarkable accuracy rate of 98%. The success of stress classification from facial images has practical implications in healthcare, psychology, and human-computer interaction. It is important to acknowledge that the accuracy of the model could be impacted by the dataset's quality and the specific techniques used for data preparation and model training. Additionally, it's important to consider the ethical aspects of utilizing facial recognition technology for stress classification and recognize and reduce any potential biases.

In conclusion, the study's results indicate that Mobilenet has the potential to classify stress based on facial images, and further investigation in this area could significantly enhance our comprehension and management of stress. In the future, stress can be detected through various means such as facial expressions, physiological signals (heart rate, skin conductance), and speech patterns. By combining these indicators with facial images, the accuracy and reliability of stress classification could be improved significantly. Moreover, if the model is optimized for real-time processing, it could be used to develop mobile or wearable devices that monitor stress levels in real-time. This could be beneficial for people seeking to manage their stress more effectively or for clinicians to monitor their patients remotely.

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