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Python Based Stress Detection System Using Machine Learning & Algorithm's

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Abstract - In today's high-pressure world, the need for innovative, non-intrusive stress monitoring solutions is more critical than ever. This paper introduces a sophisticated stress detection system that combines facial expression analysis with machine learning to deliver real-time, continuous stress assessment. Our system employs Haar Cascade classifiers for precise face detection, CNN for feature extraction and utilizes the K-Nearest Neighbors (KNN) algorithm to classify stress-related facial expressions. A significant advantage of our system is its non-intrusive nature, relying solely on visual data, thus eliminating the need for cumbersome wearable sensors. This enhances user comfort and convenience. This paper outlines the design, implementation, and evaluation of our stress detection system, emphasizing its potential applications in workplace wellness, mental health monitoring, and human-computer interaction

Key Words: - KNN, Facial Expressions, Machine Learning, Stress Detection, Image Processing, CNN

1.INTRODUCTION

In today's fast-paced world, stress has become an ubiquitous part of daily life, affecting individuals' mental and physical well-being. Traditional methods for monitoring stress, such as self-assessment surveys and physiological measurements, often fall short due to their intrusive nature and the requirement for specialized equipment. As such, there is a pressing need for innovative, non-intrusive solutions that leverage modern technology to effectively detect and manage stress.

Facial expressions offer a natural and unobtrusive window into an individual's emotional state, including stress levels. Research indicates that stress can be revealed through specific facial cues, such as furrowed brows, tightened jaws, and variations in eye activity. By harnessing these subtle yet telling signs, it becomes possible to develop systems capable of accurately assessing stress levels through facial analysis.

This paper introduces a comprehensive stress detection system that synergizes the simplicity and robustness of the K-Nearest Neighbors (KNN) algorithm with the precise facial detection capabilities of Haar Cascade classifiers. The system is designed to operate seamlessly in real-time, providing continuous stress monitoring through several key stages: face detection, feature extraction, stress classification, and real-time deployment. his paper elaborates on the design, implementation, and evaluation of our stress detection system, demonstrating its potential to transform stress monitoring practices. The proposed solution not only addresses the limitations of traditional methods but also offers a scalable and practical tool for applications in workplace wellness, mental health monitoring, and beyond.

2. LITERATURE SURVEY

In machine learning, we frequently discover that simple algorithms can give better results than sophisticated ones. Our article will use the harcascade method for feature extraction and ensemble learning algorithms like KNN, SVM, and Naïve Bayes for classification to improve accuracy.

[1] CNN Learning Technique for Interpreting Face Expressions, DONG-HWAN LEE, JANG-HEE YOO, et al. This paper proposes a novel divide-and-conquer learning strategy to improve facial expression recognition (FER). It integrates a ResNet-18 deep neural network for expression recognition with MobileNet for face area detection.

[2] A Machine Learning based Stress Analysis and Suicidal Ideation Detection System using Questionnaires and Twitter Year of Publication: 2019

Authors: Swati Jain, Suraj Prakash Narayan, Rupesh Kumar Dewang, Utkarsh Bhartiya, Nalini Meena and Varun Kumar. With an endless increase in the menace of Stress, there is a demand to develop automatic techniques for the detection of the presence and extent of Stress thereby stopping new events to occur. Therefore, the motivation of this paper, is to explore the whole different sources of information, like social media posts, blogs, language, and action cues, to predict the severity of Stress.

[3] Title: Stress recognition using machine learning methods with different feature generation strategies .Year: 2021 Author: Xiaowei Lia , Xin Zhanga , Jing Zhua , Wandeng

Maoa , Shuting Suna , Zihan Wanga , Chen Xiaa , Bin Hua,Mishra.

This paper aims at better recognizing Stress using the transformation of EEG features and machine learning methods.

Many researchers combine EEG signal with traditional feature extraction algorithms and machine learning methods, then perform supervised learning strategies to distinguish Stress patients from normal subjects.

[4] A Lightweight Convolutional Neural Network for Real-Time Facial Expression Detection, Authors NING ZHOU

RENYU LIANG: In this paper, a lightweight Convolutional Neural Network (CNN) is proposed for real-time and bulk facial emotion detection. The model utilizes Multi-task Cascaded Convolutional Networks (MTCNN) for face detection and then classifies facial emotions. Advantages are Parameter Reduction Incorporation of Depth-wise Separable Convolution.

[5] A Lightweight Facial Emotion Recognition System Using Partial Transfer Learning for Visually Impaired People, Authors DINA SHEHADA, AYAD TURKY, ABIR HUSSAIN,BILAL KHAN: This paper addresses the challenge faced by visually impaired individuals in perceiving non-verbal cues, proposing a solution through automated facial emotion recognition

[6] A Systematic Review of Facial Expression Detection Methods, Authors YOMARA PINHEIRO PIRES, FERNANDO AUGUSTO RIBEIRO COSTA: This paper highlights the significance of understanding emotions and facial expressions in human interaction and how advancements in Artificial Intelligence, particularly Deep Learning and Convolutional Neural Networks (CNNs), enable machines to infer human emotions from images.

[7] Title: Stress recognition using machine learning methods with different feature generation strategies.
Year: 2021
Author: Xiaowei Lia , Xin Zhanga , Jing Zhua , Wandeng Maoa , Shuting Suna , Zihan Wanga , Chen Xiaa , Bin Hua,Mishra.
This paper aims at better recognizing Stress using the transformation of EEG features and machine learning methods.

Many researchers combine EEG signal with traditional feature extraction algorithms and machine learning methods, then perform supervised learning strategies to distinguish Stress patients from normal subjects. For instance, Hosseinifard et al. decomposed EEG signal into four EEG bands and extracted nonlinear features (i.e. detrended fluctuation analysis (DFA), higuchi fractal, correlation dimension and lyapunov exponent) to distinguish Stress patients from normal people. The k-nearest neighbor, linear discriminant analysis and logistic regression were adopted. The best classification accuracy obtained was 83.3% when they used the correlation dimension and LR classifier among other nonlinear features.

numerical studies, which also show performance gains and fair load balancing under different network scenarios.

3. PROPOSED SYSTEM AND ALGORITHM

The current system's work on stress detection is based on digital signal processing, which takes skin temperature, blood volume, pupil dilation, and galvanic skin reaction into account. Additionally, other research on this topic uses a variety of physiological cues as well as visual cues (such as eye closure and head movement) to track an individual's stress levels while they are at work. But in practical use, these measurements are uncomfortable and invasive. The suggested Framework To classify stress, machine learning algorithms such as KNN classifiers are used. The employee's image is provided as input by the browser in the first stage of image processing for detection. Image processing is the process of transforming an image into digital form and carrying out various operations on it in order to obtain an improved image or to extract some relevant information from it. By using a picture as the input, the output might also be an image or features related to that image. The rounder box displays the emotions. Anger, Disgust, Fear, and Sadness are signs of stress. The proposed system offers the advantage of producing a changed image or report through image analysis With the help of proactive stress management techniques, the Stress Detection System helps employees deal with the problems that cause them stress. The employee's photos will be taken at regular intervals.

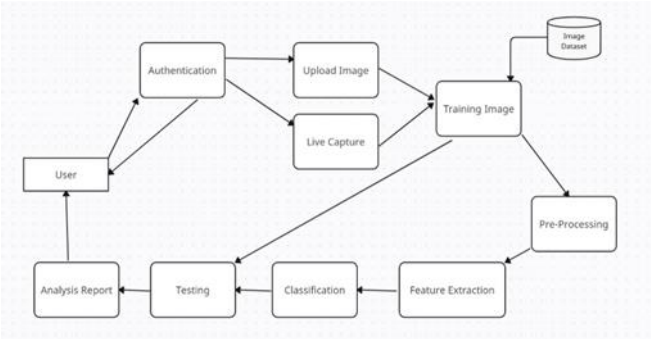


Fig -3.1: System Architecture

Algorithm Used: It is a regular occurrence for machine learning researchers to discover that simpler algorithms might yield more impressive results than more complex ones. For classification tasks, the K-Nearest Neighbors (KNN) algorithm is a straightforward but powerful machine learning method.

KNN is a key component in our stress detection system, helping to categorize facial expressions linked to various stress levels. A. Dynamic Job Ordering and Workflow Scheduling.

1) KNN Algorithm Overview:

KNN is an instance-based, non-parametric learning method that groups data points according to how similar they are to the training set's data points. The fundamental concept involves determining the 'k' closest instances (neighbors) of a given input instance and designating the class label that corresponds to their neighbors. KNN is simple to use and comprehend, and by looking at the closest neighbors, one may quickly interpret its conclusions. KNN in the identification of stress: Dlib is used to recognize facial landmarks, and pertinent features that suggest stress are retrieved. These characteristics serve as the KNN algorithm's input. The number of neighbors, or "k," is a critical hyper parameter that impacts the KNN classifier's performance. The Euclidean distances with the least values are used to determine the 'k' nearest neighbors. The class label of the test instance is decided by a majority vote after the class labels of these neighbors are retrieved. Our system can reliably identify stress levels based on facial expressions by utilizing the KNN algorithm's simplicity and efficacy, offering a reliable and understandable solution for Our system.

2] Haar cascade Algorithm:

In computer vision, Haar Cascade classifiers are a well-liked technique for object detection, especially for identifying faces in pictures. The initial stage of our stress detection system uses Haar Cascade to identify faces in the input images. Machine learning algorithms are then used to further process the images for stress detection.Using positive and negative images to train a cascade function, the Haar Cascade method is based on machine learning. It can identify items in photos with varying sizes and orientations—in this case, faces.

3] Our system employs various ensemble techniques including naïve bayes, Support Vector Machine (SVM), CNN, and others to classify stress levels.

4] CNN(Convolutional Neural Network):CNN is used to extract features from given image.

4. IMPLEMENTATION

Modules: Admin, Data Pre-process,User, and Dashboard. DESCRIPTION OF MODULES:

User: The first person to register is the User. For future correspondence, he needed a working user email address and mobile number during registration. The administrator can activate the customer after the user registers. The user can log into our system when the admin has activated the customer. The user must first provide the system with the input as an image. The features and relevant emotion of the image will be extracted by the Python module. It is also feasible to recognize many faces in a given image. We will show our degree of stress by using various facial expressions, such as sadness, anger, happy ,surprised,neutral etc.

Admin: Using his login credentials, Admin can log in. He can activate the users after logging in. Only the activated user can log in to our apps. The project administrator can dynamically set the project's training and testing data to the code. All user detected results are viewable in hid frame by the admin. He can determine the emotions depicted in the photographs by selecting a hyperlink on the screen.

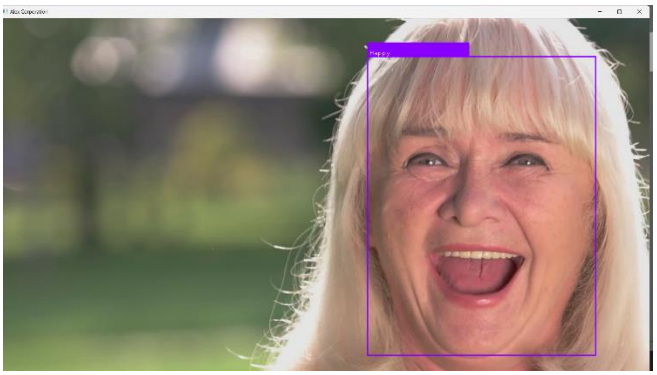
This system also have a User-friendly dashboard that stores the results of our system.

1.Homepage

2.User Registration Module

3.User Login Module

4.Result



5.Admin View Module

6. Performance Metric & Result table

Knn Algorithm Results

Accuarcy 1.0

Classification Error 0.0
Sensitivity 1.0
Specificity 1.0
False positive rate Error 0.0
Precision 1.0

Results table

	Target	Time pressure	Interruption	Stress	Physical Demand	Performance	Frustration
0	1	0.004	-0.005	2.890	18.706	95.1440	11.579
1	0	-0.008	0.846	1.859	2.578	71.1150	34.964
2	0	0.003	0.724	1.477	3.357	66.7890	38.982
3	0	0.000	0.632	17.726	9.942	81.2410	32.815
4	0	-0.593	0.442	4.826	5.824	68.1320	39.392
5	1	-0.003	1.090	8.621	18.385	89.8880	34.327
6	0	-0.003	0.173	11.517	6.629	74.7160	36.288
7	0	-0.008	0.290	5.257	4.853	69.1420	47.998
8	0	-0.006	1.155	4.473	5.378	72.3140	39.369
9	0	-0.004	0.892	7.057	7.748	79.2260	34.466
10	0	0.001	0.282	5.028	6.400	69.5590	49.665
11	0	-0.004	0.279	4.509	12.510	84.6500	46.306
12	1	0.005	0.980	11.082	17.432	96.7990	38.317
13	1	0.003	0.980	11.082	17.341	110.0650	38.317

5. CONCLUSION

Our machine learning and image processing-based stress detection system provides a practical means of tracking stress levels based on facial expressions. Although successful, we understand that in order to achieve wider adoption, we must address accuracy and privacy concerns. Our method has the potential to improve mental health management with continued refinement. Using a camera and the Har Cascade algorithm, the system uses a person's face photos as a dataset to identify facial expressions. This dataset makes it easier to calculate the beat-to-beat accuracy when determining a person's stress level.

The real-time processing capabilities of the system make it practical for everyday use, offering immediate feedback and monitoring that can be applied in various settings, from workplace wellness programs to mental health monitoring and human-computer interaction enhancements. The system's robustness is further ensured through extensive training on diverse datasets, allowing it to perform reliably across different demographic groups and environmental conditions.

In conclusion, our stress detection system represents a significant advancement in the field of emotional and psychological health monitoring. By combining sophisticated machine learning techniques with detailed facial analysis, we provide a scalable, practical solution that addresses the limitations of traditional stress monitoring methods. This system not only enhances our ability to detect and manage stress in real-time but also paves the way for future innovations in non-intrusive health monitoring technologies.

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