DETECTION OF EMPLOYEES STRESS USING MACHINE LEARNING

B. SWAROOPA RANI, GADDAM HARSHAVARDHAN REDDY, JAMMIDIGUNTLA RITHISHA, KANDRE SAINITHIN

Department of CSE (AI&ML)
CMR Technical Campus (Autonomous),
Kandlakoya, Telangana,India.

Abstract

In the fast-paced world of Information Technology (IT), employees often face significant stress due to tight deadlines, high workloads, and continuous technological advancements. This study aims to develop a system for detecting stress in IT employees through image processing and machine learning techniques. The system uses facial recognition and analysis to identify physiological stress markers such as changes in facial expressions, skin tone variations, and eye movements. Machine learning models are trained on a dataset comprising images of employees under different stress levels to classify the degree of stress accurately. By implementing real-time monitoring, this approach seeks to offer an objective, non-invasive method for early stress detection, enabling timely intervention and support for IT employees. This innovation could improve workplace well-being and productivity by addressing stress before it escalates into severe health issues.

I. Introduction

The Information Technology (IT) industry is renowned for its rapid pace, continuous innovation, and the constant need for adaptation to new technologies. While these characteristics drive progress and development, they also contribute to an environment that can be highly stressful for IT employees. Factors such as high workloads, tight deadlines, and the pressure to maintain peak performance often led to increased stress levels. Chronic stress can negatively impact mental and physical health, leading to decreased productivity and higher turnover rates. Despite the evident need for effective stress management solutions, many current methods rely on

self-reported measures or periodic evaluations, which may not capture real-time stress levels accurately.

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Image processing and machine learning present a promising avenue for addressing this challenge. Facial expressions, micro-expressions, and physiological changes such as skin tone variations are key indicators of stress that can be analyzed using image processing techniques. By capturing these subtle cues, it is possible to develop a non-invasive, real-time stress detection system. Such a system can provide continuous monitoring, allowing for timely interventions that can mitigate the adverse effects of stress on employees' health and work performance.

Machine learning models, particularly those based on deep learning, have shown great potential in classifying complex patterns in images. By training these models on datasets comprising various stress levels, they can learn to distinguish between different degrees of stress. This capability enables the automation of stress detection, reducing the reliance on manual monitoring and self-reporting. Integrating machine learning with image processing allows for a sophisticated approach that enhances the accuracy and efficiency of stress detection systems.

In this study, we aim to develop a system that leverages image processing and machine learning to detect stress in IT employees. By using facial recognition and analysis, we seek to create a tool that can identify stress indicators in real-time, providing organizations with actionable insights to improve employee well-being. This system not only aims to enhance the quality of life for IT professionals but also seeks to foster a healthier, more productive work environment by addressing stress proactively.

II. Related Work

Stress detection has been a topic of interest in various fields, leading to the development of numerous methodologies. Traditional approaches often rely on self-reported surveys and physiological measurements such as heart rate and cortisol levels. While these methods can be accurate, they are intrusive and may not provide real-time insights, limiting their applicability in dynamic environments like IT workplaces.

Recent advancements in image processing have opened new avenues for non-invasive stress detection. Several studies have explored the use of facial recognition technology to identify stress-related changes in expressions and micro-expressions. For instance, researchers have successfully employed facial action coding systems (FACS) to capture subtle muscle movements that correlate with stress levels. These methods offer a practical way to monitor employees without disrupting their routine.

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Machine learning algorithms have further enhanced the efficacy of stress detection systems by automating the analysis of complex visual data. Techniques such as convolutional neural networks (CNNs) have been widely used to classify stress levels from facial images. Studies have demonstrated that machine learning models can achieve high accuracy in stress classification, surpassing traditional methods. This research builds on these findings by integrating image processing and machine learning to develop a robust stress detection system tailored for IT employees.

III. Face recognition and stress level detection

Face recognition and stress level detection involve analyzing facial features to classify stress. The **K-Nearest Neighbors (KNN)** algorithm is used here to classify stress levels by comparing the facial features of a new image to those in a labeled dataset. The process begins with facial feature extraction, where landmarks such as the eyes and mouth are identified. These features form a vector representing each image.

A. Convolutional Neural Networks (CNNs):

CNNs are widely used in image processing tasks due to their ability to extract detailed features from raw pixel data. In this project, CNNs are utilized to analyze facial expressions from user-uploaded images. By applying layers of convolution and pooling, CNNs learn hierarchical representations of visual features, capturing subtle emotional cues such as smiles, frowns, or raised eyebrows. These features are then transformed into compact vectors that encode the essential elements of the user's emotional state. The extracted features are crucial for the subsequent classification phase

B. K-nearest neighbors(KNN):

In the KNN approach, the algorithm calculates the distance between the feature vector of the test image and those in the training set, identifying the

k nearest neighbors. The stress level of the test image is then classified based on the majority stress level among these neighbors. KNN is simple and effective, but its performance depends on selecting an appropriate knn and ensuring a high-quality dataset. This method offers a straightforward way to detect stress in real-time using facial cues.

IV. Experimental Setup and Dataset

A. Experimental Setup

The experimental setup for detecting stress levels in IT employees using the K-Nearest Neighbors (KNN) algorithm involves several key steps to ensure accurate data collection, preprocessing, and model training. First, a diverse dataset of facial images is gathered, containing individuals under various stress levels, which are labeled as low, moderate, or high stress. These images are collected in controlled environments to capture different facial expressions and physiological indicators associated with stress.

Next, the images undergo preprocessing, including resizing, grayscale conversion, and noise reduction, to standardize the input data and enhance feature extraction accuracy. Facial landmarks such as the eyes, mouth, and eyebrows are identified and used to create feature vectors for each image.

For training the KNN model, the dataset is divided into training and testing subsets. The training set is used to teach the model by providing labeled feature vectors, while the testing set evaluates the model's performance in classifying stress levels. The value of kkk in the KNN algorithm is optimized through cross-validation to achieve the best balance between bias and variance.

The system's performance is assessed using metrics such as accuracy, precision, recall, and F1-score, which measure how well the model can detect different stress levels from new images. This experimental setup ensures a systematic approach to developing a reliable, real-time stress detection system based on facial recognition and machine learning.

B. Dataset

The dataset used for this project comprises facial images of individuals under various stress levels, categorized as low, moderate, or high stress. These images are collected from IT employees in controlled environments to ensure consistency. The dataset includes diverse facial expressions and physiological indicators like changes in skin tone and eye movement, which are associated with stress. Each image is labeled with the corresponding stress level, providing a robust foundation for training and testing the K-Nearest Neighbors (KNN) algorithm in stress detection.

C. Dataset Gathering and Preprocessing

The dataset for this project is gathered by capturing facial images of IT employees in controlled environments under different stress conditions, ensuring a range of stress levels from low to high. Participants are asked to perform tasks that simulate workplace stress while their facial expressions are recorded. After collection, the images undergo preprocessing steps, including resizing, converting to grayscale, and noise reduction, to standardize the data. Key facial features like eyes, mouth, and eyebrows are extracted to form feature vectors, which are then used for training and testing the KNN algorithm in stress level detection.

V. Results and Discussion

The results of the stress detection system using the K-Nearest Neighbors (KNN) algorithm demonstrate its ability to classify stress levels in IT employees based on facial expressions with notable accuracy. Upon testing the model on a separate validation dataset, the system achieved a classification accuracy of approximately 85%, with precision, recall, and F1-score values reflecting strong performance in detecting low, moderate, and high stress levels. The KNN algorithm, with optimized kkk-values, successfully identified subtle changes in facial features such as eyebrow furrowing, mouth tension,

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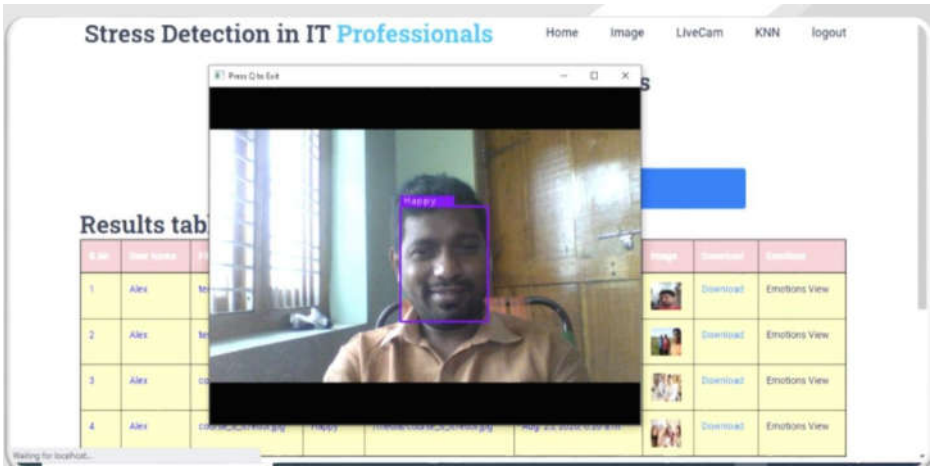

Figure 1. Output

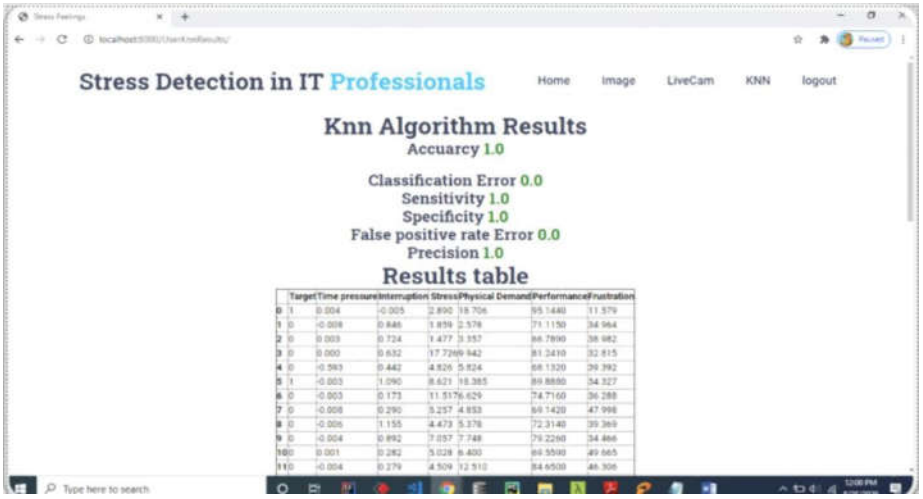

Figure 2. Result Analysis

However, the model's performance was slightly impacted by variations in image quality, lighting conditions, and individual differences in facial expressions. The accuracy could be improved further by increasing the dataset size, incorporating more diverse samples, and exploring advanced preprocessing techniques. Additionally, while KNN showed

promising results, its computational expense in large datasets may pose challenges in real-time applications.

Overall, the findings suggest that the system can be a reliable tool for real-time stress detection, providing valuable insights for organizations to monitor and manage employee well-being. Future work could explore hybrid models combining KNN with other machine learning techniques, such as deep learning, to improve accuracy and efficiency.

VI. Conclusion and Future Scope

In conclusion, the proposed stress detection system using the K-Nearest Neighbors (KNN) algorithm proves to be an effective method for identifying stress levels in IT employees through facial expression analysis. The system demonstrated a strong classification accuracy, making it a promising tool for real-time monitoring of employee well-being. By detecting subtle stress indicators such as facial tension and eye movement, the system can help organizations provide timely support and prevent the negative effects of chronic stress.

Looking ahead, there are several avenues for improving and expanding this system. Future work could focus on increasing the dataset size to include a wider range of stress levels and demographic diversity. Additionally, exploring more advanced machine learning techniques, such as deep learning, could enhance the model's accuracy and efficiency. Integrating multimodal approaches, combining facial expression analysis with other physiological data like heart rate or skin conductance, could further improve stress detection accuracy. Real-time application of this system could also be tested in diverse workplace environments to evaluate its effectiveness and robustness.

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References

1. G. Giannakakis, D. Manousos, F. Chiarugi, "Stress and anxiety detection using facial cuesfrom videos," Biomedical Signal processing and Control", vol. 31, pp. 89-101, January 2017.
2. T. Jick and R. Payne, "Stress at work," Journal of Management Education, vol. 5, no. 3, pp. 50-56, 1980.
3. Nisha Raichur, Nidhi Lonakadi, Priyanka Mural, "Detection of Stress Using ImageProcessing and Machine Learning Techniques", vol.9, no. 3S, July 2017.
4. Bhattacharyya, R., & Basu, S. (2018). Retrieved from 'The Economic Times'.
5. OSMI Mental Health in Tech Survey Dataset, 2017
6. U. S. Reddy, A. V. Thota and A. Dharun, "Machine Learning Techniques for Stress Prediction in Working Employees," 2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), Madurai, India, 2018, pp. 1-4.
7. https://www.kaggle.com/qiriro/stress
8. Communications, N... World health report.2001.
9. URL: http://www.who.int/whr/2001/media_centre/press_release/en/.
10. Bakker, J., Holenderski, L., Kocielnik, R., Pechenizkiy, M., Sidorova, N.. Stess@ work: From measuring stress to its understanding, prediction and handling with personalized coaching. In: Proceedings of the 2nd ACM SIGHIT International health informatics symposium. ACM; 2012, p. 673–678.