STRESS RECOGNITION FROM FACIAL EXPRESSIONS

Fatima Pirzada
Department of Computer Science
FAST NUCES
Lahore, Pakistan
l215487@lhr.nu.edu.pk

Hafsah Zulqarnain
Department of Computer Science
FAST NUCES
Lahore, Pakistan
l215315@lhr.nu.edu.pk

Tania Waseen
Department of Computer Science
FAST NUCES
Lahore, Pakistan
l215480@lhr.nu.edu.pk

ABSTRACT

This project introduces an AI-powered stress recognition system utilizing deep learning techniques to analyze facial expressions for real-time stress assessment. Stress, a pervasive concern impacting health and productivity, often eludes traditional detection methods reliant on subjective self-reporting. The proposed system addresses this limitation by objectively identifying stress markers through facial expressions.

1 INTRODUCTION AND MOTIVATION

In the realm of emotions, certain facial expressions, notably anger, disgust, fear, happiness, and sadness, are universally recognized across cultures. Stress, while lacking a universally distinct facial expression, has been associated with recognizable manifestations in facial expressions, gestures, and vocal cues. Studies affirm the correlation between negative emotions like anger, disgust, and fear with stress, validated through physiological markers such as increased cortisol levels and cardiac activity. This acknowledgment of the interplay between facial expressions and stress forms a foundational aspect of our exploration into stress recognition from facial expressions (1).

Stress is a prevalent issue in modern society, adversely affecting health, productivity, and overall well-being. Early detection of stress allows for timely intervention and implementation of stress-reducing strategies. Traditional methods for stress detection rely on self-reporting, which can be subjective and unreliable.

Applications:

- ***Workplace wellness***: Identifying stressed employees can help implement stress reduction programs and improve work environments.
- ***Mental health support***: Early detection of stress can lead to faster intervention for individuals struggling with anxiety or depression.
- ***Education***: Monitoring student stress levels can help educators personalize learning experiences and identify students needing additional support.

This project is motivated by the potential to provide a non-invasive and real-time solution for stress assessment, which can have significant implications for mental health monitoring and intervention.

2 CHALLENGES

- ***Facial Expression Variability:*** Facial expressions can vary greatly among individuals and across different cultural contexts, making it challenging to accurately interpret stress-related cues.
- ***Subtlety of Stress Indicators:*** Stress expressions may be subtle and easily missed by conventional computer vision algorithms, requiring robust feature extraction techniques.
- ***Handling Input as Images:*** Dealing with facial expressions as input images introduces technical complexities in preprocessing and feature extraction. Ensuring robust image handling, resolution normalization, and effective feature representation are key challenges in optimizing model performance.
- ***Data Acquisition and Annotation:*** Collecting and annotating a diverse dataset of facial expressions in various stress-inducing scenarios can be time-consuming and resource-intensive.
- ***Model Generalization:*** Ensuring the model's ability to generalize across different demographics, lighting conditions, and camera angles is crucial for real-world deployment.

3 DIFFERENTIATION FROM EXISTING SOLUTIONS

The existing systems for emotion detection often rely on measurements of only few facial features like lips and eyes. However, these approaches struggle to accurately identify nuances such as stress levels. (2). Our proposed solution aims to leverage deep learning techniques for more robust and accurate stress recognition from facial expressions including furrowed brows, clenched jaws, nostril flaring etc., potentially offering more reliable solutions compared to traditional methods. Many existing systems do exist, however very few use images as input to detect stress rather focusing more on self-reported measures or other measures like heart beat and blood pressure. While some facial expression recognition systems exist, they may not specifically target stress detection or lack the accuracy needed for real-world applications. Furthermore, prior research is predominantly conducted with specific demographic groups, often comprising of white individuals, our project emphasizes inclusivity by integrating people from diverse backgrounds and ethnicities. This approach aims to enhance the accuracy and generalizability of stress recognition from facial expressions across a broader spectrum of human experiences.

4 HIGH-LEVEL ARCHITECTURE

- ***Data Acquisition:*** Capture image data of individuals exhibiting a range of expressions ranging from sad, angry and even neutral expressions then detect stress on the basis of these expressions.
- ***Preprocessing:*** Apply image processing techniques like cropping, normalization, and noise reduction.
- ***Facial Landmark Detection:*** Identify key facial features (eyes, mouth, eyebrows) using pre-trained models.
- ***Feature Extraction:*** Extract relevant features from the facial landmarks that signify stress (e.g., brow furrow, lip corners).
- ***Deep Learning Model Training:*** Train a Convolutional Neural Network (CNN) on the extracted features and labeled stress levels.
- ***Stress Recognition:*** Analyze user's facial features in real-time using the trained model to detect stress.
- ***Output:*** Provide visual or textual indication of the detected stress level.

5 AVAILABLE DATASETS

- **CK+ (Cohn-Kanade Extended) Dataset:** Contains facial expression sequences with annotated emotions, including stress-related expressions.

- **AFF-Wild Dataset:** A large-scale dataset of facial expressions in the wild, including stress-related scenarios.
- Self-collected data from stress-inducing tasks or scenarios, annotated with stress levels.

REFERENCES

[1] José Almeida and Fátima Rodrigues. Facial expression recognition system for stress detection with deep learning. In *Proceedings of the 23rd International Conference on Enterprise Information Systems (ICEIS 2021)- Volume 1*, pages 256–263, Porto, Portugal, 2021. SCITEPRESS–Science and Technology Publications, Lda. All rights reserved, Polytechnic of Porto, School of Engineering. Facial Expression Recognition System for Stress Detection with Deep Learning.

[2] Anjali R, J. Babitha, Rithika W, and Ms. Reeja S.L. Stress detection based on emotion recognition using deep learning. In *Proceedings of the National Conference on Smart Systems and Technologies*, Thiruvananthapuram, India, 2024.