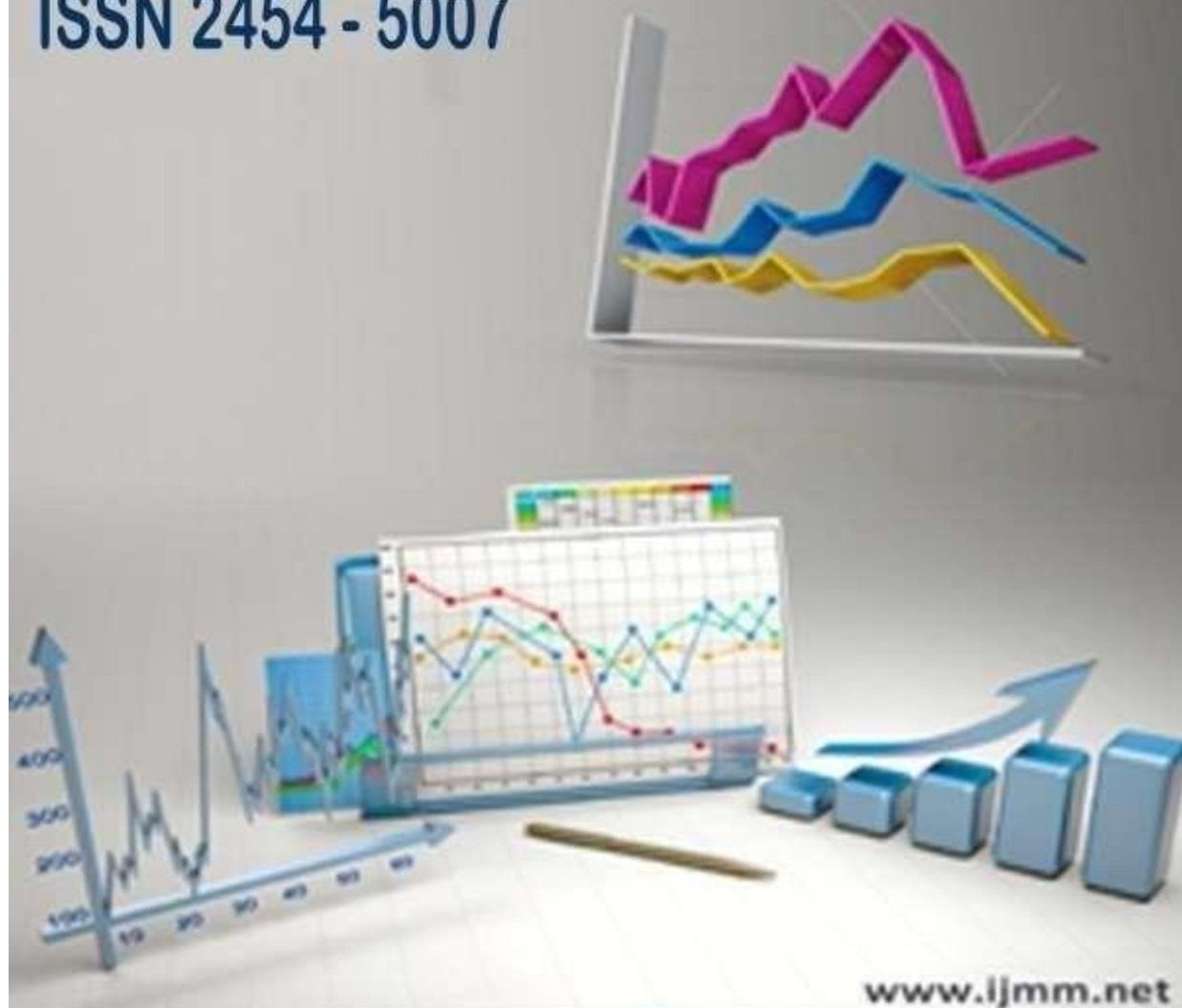




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Mental Stress Detection via Facial Cues

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ABSTRACT

Stress has become one of the most common psychological issues in today's fast-paced lifestyle, adversely affecting both mental and physical health. Traditional methods are either invasive, costly, or subjective. This project proposes a non-invasive, AI-based stress detection system that analyses facial cues in real time. The proposed system offers functionalities such as Login, Signup, Dashboard and history tracking. The system uses OpenCV for video capture and face detection, while dlib's 68-point facial landmark predictor is applied to extract significant facial features. These features are passed to a Convolutional Neural Network (CNN) model which performs emotion classification. The detected emotion is then mapped into stress categories. This project demonstrates the potential of AI in mental health monitoring and provides a foundation for future enhancements.

KEYWORDS CNN (Convolutional Neural Network), OpenCV, Dlib's 68-point, Machine Learning, Facial Expression Classification.

INTRODUCTION

One of the most common problems in contemporary life is stress, which affects people of all ages, from workers juggling demanding workloads to students getting ready for tests. A small level of stress can boost motivation, but chronic stress can cause major mental and physical health issues like anxiety, melancholy, and heart disease. Even though they are accurate, traditional stress detection techniques like EEG, ECG, or cortisol testing are expensive and unsuitable for everyday use. Facial expressions are accurate markers of psychological states since they naturally alter when under emotional stress. The goal of this project is to create a real-time, non-invasive, and affordable stress detection system that analyses facial cues and

instantaneously predicts stress levels using a standard webcam in conjunction with image processing and deep learning algorithms. Accessible mental health monitoring technologies are becoming more and more necessary in today's fast-paced world, where stress is unavoidable in healthcare, educational, and job environments. The majority of current approaches, including self-report questionnaires and sensor-based systems, are unreliable, costly, or invasive. The goal of this project is to create a real-time, non-invasive, and affordable stress detection system that analyses facial cues and instantaneously predicts stress levels using a standard webcam in conjunction with image processing and deep learning algorithms. The majority of current approaches, including self-report questionnaires and sensor-based systems, are unreliable, costly, or invasive.

LITERATURE SURVEY

The literature survey indicates that previous stress detection methods, though effective, faced major limitations. Kachuee et al. (2019) used wearable sensors like ECG and PPG with machine learning, achieving high accuracy but requiring intrusive hardware. Zhang et al. (2017) and Molla Hosseini et al. (2019) employed CNN-based facial emotion recognition, which performed well

but depended on large datasets and high computational power. Seneviratne et al. (2020) integrated facial, voice, and physiological signals for improved accuracy but needed multiple devices. Overall, existing approaches are often costly, hardware-dependent, and unsuitable for real-time use. To address these gaps, our project introduces a lightweight CNN-based model that uses only a webcam for facial stress detection, offering a practical, real-time, and non-intrusive solution.

RELATED WORK

Several studies have explored stress detection using physiological, psychological, and visual modalities. Kachuee et al. (2019) proposed a sensor-based approach using ECG and PPG signals with machine learning models, achieving high accuracy but with intrusive hardware requirements. Despite these advancements, existing systems often face challenges such as high computational cost, dependence on specialized equipment, and limited scalability. Addressing these limitations, the proposed system integrates OpenCV and Dlib for facial detection and landmark extraction with a CNN-based deep learning model deployed via a Flask web application and SQLite database, providing an efficient, non-intrusive, and cost-effective solution for real-time stress detection.

EXISTING METHOD

In the existing methods, stress detection is commonly performed using physiological signals such as EEG, ECG, or PPG, which require wearable sensors and are often invasive and costly. Some studies have used facial expression analysis with machine learning models like SVM or traditional CNNs, but their accuracy heavily depends on large datasets and controlled environments. These systems face difficulties when lighting, facial angles, or occlusions vary. Moreover, existing models demand high computational power and are not suitable for real-time applications on regular devices. Many systems also lack user-friendly interfaces or history tracking features. As a result, current approaches are often complex, hardware-dependent, and impractical for everyday mental health monitoring.

PROPOSED METHOD

The proposed system enhances existing methods by replacing sensor-based and high-cost equipment with a non-invasive, webcam-based approach. Instead of using physiological signals like ECG or EEG, the system employs OpenCV for real-time video capture and dlib's 68-point facial landmark detector for accurate feature extraction. These facial features are then

processed using a Convolutional Neural Network (CNN), which classifies emotions linked to stress levels. The classified emotions are mapped into stress categories such as low, medium, or high. A Flask web framework is used to integrate all modules, including Login, Signup, Dashboard, and History Tracking, while SQLite handles data storage efficiently. This combination of advanced deep learning, image processing, and web integration provides a lightweight, accurate, and real-time stress detection system that is cost-effective and user-friendly compared to traditional invasive methods.

SYSTEM ARCHITECTURE

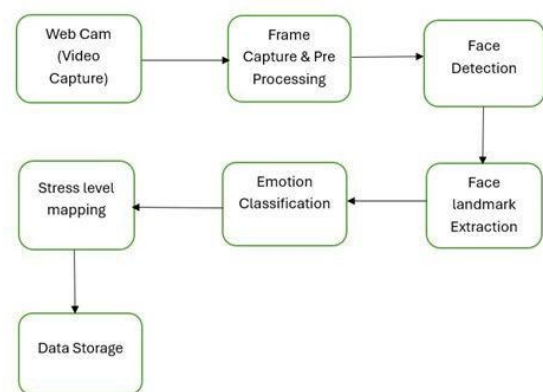


Fig1: Architecture of Mental stress Detection via Facial Cues

METHODOLOGY DESCRIPTION

Video Capture: The system uses a standard webcam to capture live video of the user. OpenCV is employed for continuous frame

acquisition, providing real-time input for further processing.

Preprocessing: Captured frames are converted to grayscale, resized, and normalized to improve clarity and reduce noise. This step ensures uniform input for face detection and emotion recognition.

Face Detection: OpenCV's face detection algorithms identify the region of interest (ROI) that contains the user's face. This step helps isolate the face from the background for accurate analysis.

Facial Landmark Extraction: Using dlib's 68-point facial landmark predictor, key facial features such as the eyes, eyebrows, nose, and mouth are detected. These points help identify changes in facial expressions related to stress.

Emotion Classification: The extracted facial features are passed to a Convolutional Neural Network (CNN) model that classifies the user's emotion (happy, sad, angry, neutral, etc.) based on facial patterns.

Stress Level Mapping: Each emotion is mapped to a corresponding stress category- Low, Medium, or High, depending on its emotional intensity.

Data Storage: The stress results, along with timestamps, are stored in an SQLite

database for maintaining a history of stress readings.

Dashboard Visualization: Through a Flask-based web interface, the system displays the user's current stress level and history in an easy-to-understand dashboard with real-time updates.

RESULT AND DISCUSSION

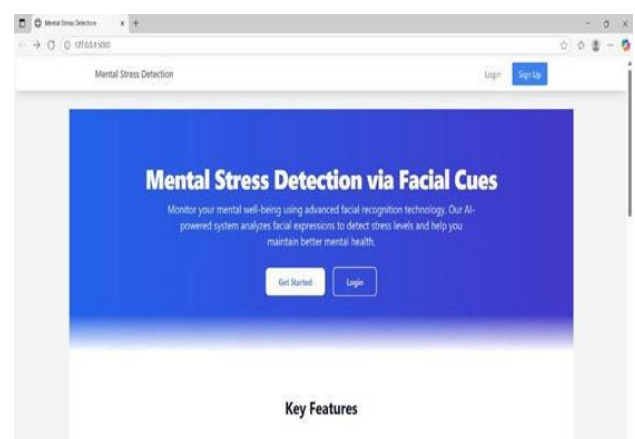


Fig2: Login and Sign-up page

The home page of the Mental Stress Detection System. The page offers options to Get Started, Login, or Sign Up, making it simple for new users to create an account and existing users to access their dashboard.

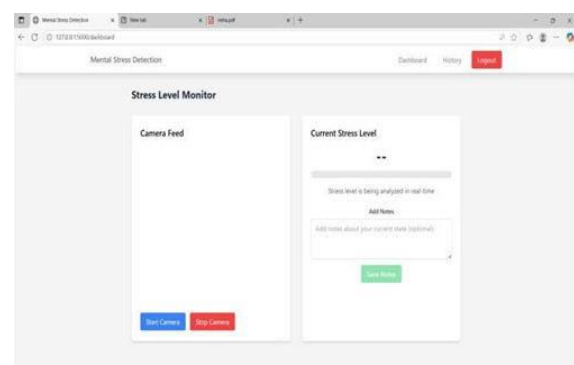


Fig3: Main Page

This is stress detecting which will open after logging in. there will be start and stop camera buttons, on the right side there will be current stress level detection and it also provides a option of storing the data.

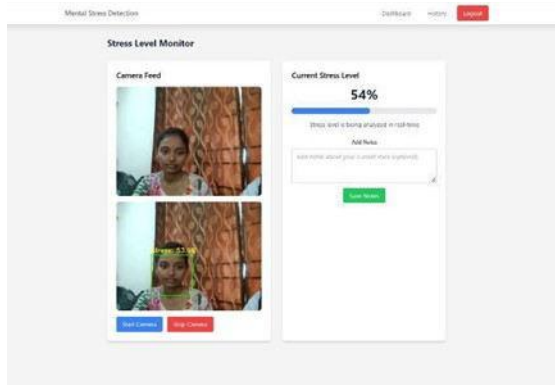


Fig4: Stress Detection Page

The system detects the face and displays a stress level of 54%, along with an option for the user to add notes.

CONCLUSION

The “Mental Stress Detection via Facial Cues” project provides a real-time, non-invasive system to detect stress using facial expressions. OpenCV and dlib extract facial features, and a CNN classifies emotions to map stress levels accurately. Results show reliable performance and practical usability for everyday monitoring.

FUTURE SCOPE

In the future, the system can be enhanced with advanced deep learning models like Vision Transformers or CNN-LSTM hybrids for higher accuracy. Multimodal

inputs such as voice or physiological signals can improve assessment, while cloud and mobile deployment will allow real-time monitoring for multiple users. AI-driven personalized feedback can further support stress management and mental well-being.

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