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Stress Detection in it Professionals Using Image Processing and Machine Learning

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ABSTRACT: IT professionals frequently face high psychological pressure due to workload, deadlines, and prolonged screen exposure. Continuous unmanaged stress leads to decreased productivity, burnout, and health complications. This project proposes a machine-learning-based stress detection system that analyzes facial expressions using image processing to classify stress levels in real time.

The system uses facial landmark extraction, CNN-based emotion classification, SVM/Random Forest classifiers, and preprocessing techniques such as Haar Cascade detection, Histogram Equalization, and Feature Encoding. The model predicts three classes — **Low Stress, Medium Stress, and High Stress** — and provides analytics for monitoring stress patterns.

Experimental results demonstrate that deep learning models outperform traditional ML, achieving high accuracy in detecting stress-related facial cues. This project aims to support organizations in improving employee well-being through early stress identification.

KEYWORDS: Stress detection, image processing, CNN, emotion recognition, mental health monitoring, machine learning.

I. INTRODUCTION

Stress has become a growing concern in the IT industry due to increased workload, irregular schedules, and prolonged digital interactions. Early identification of stress can help prevent burnout, anxiety, and performance decline. Traditional stress assessment techniques (self-report, surveys, HR feedback) are subjective and time-consuming.

Recent developments in image processing and machine learning enable computer systems to analyse facial expressions that reveal emotional states linked to stress. Techniques such as facial landmark detection, convolutional neural networks (CNN), and deep feature extraction can recognize subtle muscle movements like brow tension, eye strain, and frowning — all of which correlate with stress.

This project aims to design and develop an automated system that detects stress levels using facial images of IT professionals. The model classifies stress patterns and displays analytics that can be used by organizations or individuals to track mental health trends.

II. SYSTEM DESIGN

A. Architecture Overview

The system uses a hybrid approach combining image processing and machine learning. It consists of:

- **Input Layer:** Webcam or image dataset (facial images of IT professionals).
- **Image Preprocessing Unit:** Face detection, cropping, resizing, grayscale conversion.
- **Feature Extraction Unit:** Facial landmarks (dib), CNN-based features, GLCM texture extraction.
- **Machine Learning Model:** CNN, SVM, Random Forest, or Mobile Net/VGG16 for stress classification.
- **Output Layer:** Predicted stress level + dashboard analytics.

The architecture supports real-time prediction and user-friendly deployment.



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B. Data Flow

1. User's face is captured through a webcam or uploaded image.
2. Preprocessing removes noise, enhances features, and detects the facial region.
3. Feature extraction identifies patterns such as:
 - eyebrow tension
 - eye openness
 - lip curvature
 - forehead wrinkles
4. Extracted features are fed into ML/DL models.
5. The classifier predicts stress level: **Low, Medium, High**.
6. Results are stored and visualized in the analytics dashboard.

III. LITERATURE REVIEW

1. Stress Detection Using Facial Emotion Recognition

Studies show that stress can be inferred from micro-expressions. CNN-based emotion models (Ekman et al.) provide strong accuracy in recognizing sadness, fear, and anger, which correlate with stress.

2. Machine Learning Approaches for Mental State Classification

Work by Sharma & Gupta demonstrates that SVM and Random Forest achieve significant accuracy in stress classification using facial features and physiological cues.

3. Deep Learning Models (CNN, VGG, MobileNet)

Deep CNN architectures extract hierarchical features such as wrinkles, eye strain, and tension points. Research shows that VGG16 and MobileNet outperform shallow models on facial emotion datasets.

4. Image Processing Techniques

Papers highlight the use of:

- **Haar Cascades** for face detection
- **LBPH** for emotion classification
- **GLCM** for texture analysis of facial tension
- **Histogram Equalization** for image enhancement

5. Workplace Stress Assessment

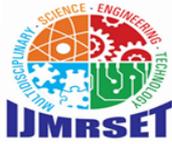
Studies state that IT employees face high risk of stress due to workload and multitasking. Automated tools for mental health monitoring can support HR wellness programs.

Problem Statement

IT professionals are highly vulnerable to mental stress due to tight deadlines, excessive workloads, unpredictable working hours, and constant exposure to computer screens. Prolonged stress in this environment leads to decreased productivity, lack of concentration, burnout, anxiety, and long-term health problems.

Traditional methods of stress assessment — such as manual surveys, interviews, and self-reported questionnaires — are subjective, time-consuming, and often inaccurate because individuals may hide or underreport their stress levels. Moreover, organizations lack real-time tools to continuously monitor or identify early signs of stress.

Facial expressions and micro-expressions are strong indicators of emotional and psychological states. These subtle facial changes are often involuntary and can reveal stress levels more reliably than verbal responses. With advancements in image processing and machine learning, it is now possible to automatically detect stress by analyzing facial cues such as eye strain, frowning, tightened lips, and muscle tension.



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IV. OBJECTIVES

Primary Objectives

1. To design and develop a real-time stress detection system that analyzes facial images of IT professionals using image processing techniques.
2. To classify stress levels (Low, Medium, High) using machine learning and deep learning models.
3. To extract stress-related facial features such as muscle tension, eye strain, and micro-expressions using advanced image processing methods.

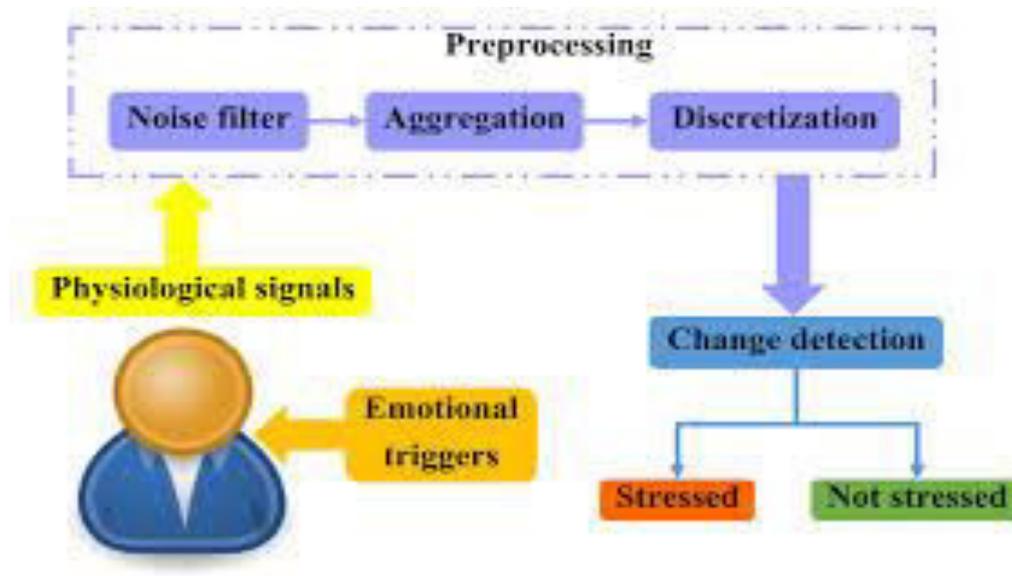
Secondary Objectives

1. To study and compare different machine learning algorithms (SVM, Random Forest, CNN, Mobile Net, VGG16) for stress detection accuracy.
2. To perform preprocessing of input images including face detection, noise removal, cropping, grayscale conversion, and normalization.
3. To build a dataset of facial images representing various stress levels, specifically focusing on IT working environments.

Analytical & Dashboard Objectives

1. To visualize predicted stress levels using graphical dashboards, charts, and trend analysis.
2. To identify stress patterns based on time, workload, or environmental conditions.
3. To generate alerts/reports that can help organizations take proactive steps to reduce stress.
4. To create a mobile or web application for real-time employee wellness monitoring.
5. To enhance deep learning models with more training data for improved generalization and precision.

Block Diagram

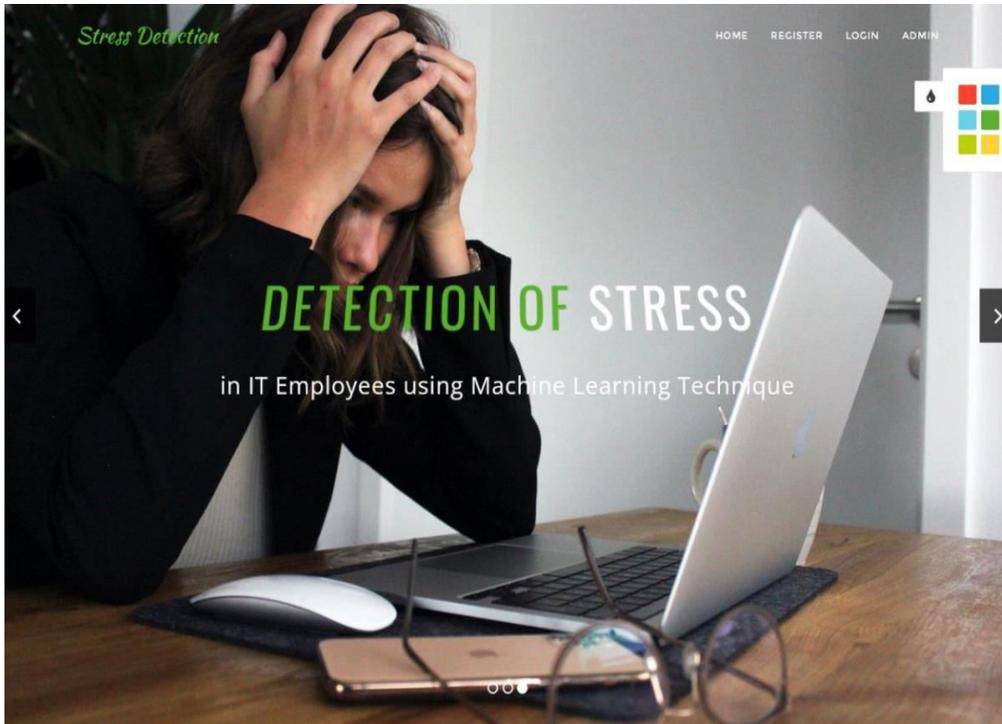


DETAILED OVERVIEW OF PAGES IN STRESS DECETION IN IT PROFESSIONAL



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HOME PAGE: The Homepage serves as the landing screen of the stress detection system. It provides users with an overview of the project, its purpose, and available actions such as login, user guidelines, and system features.

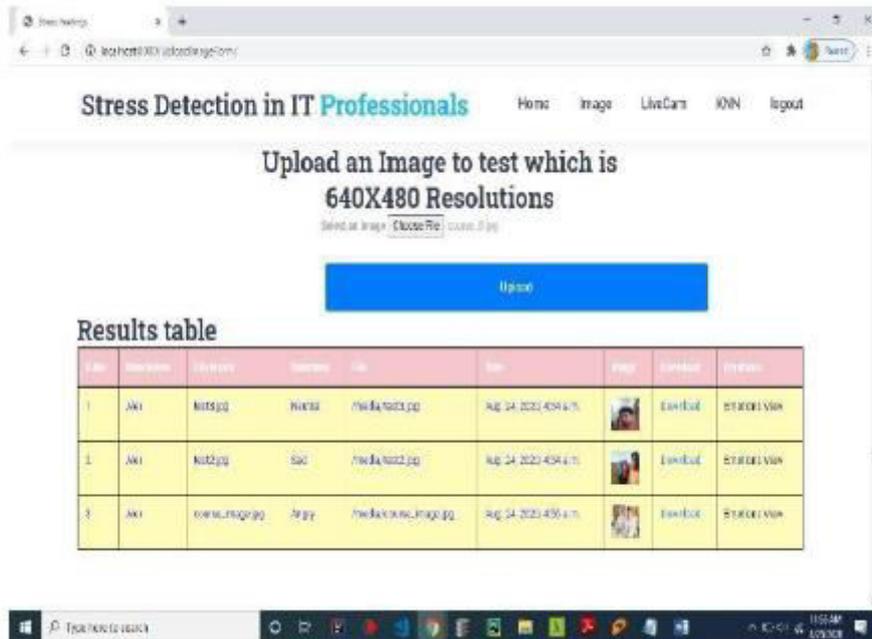


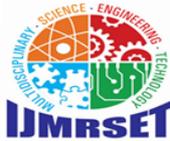
LOGIN PAGE: The Login Page ensures secure access to the system for employees and administrators.



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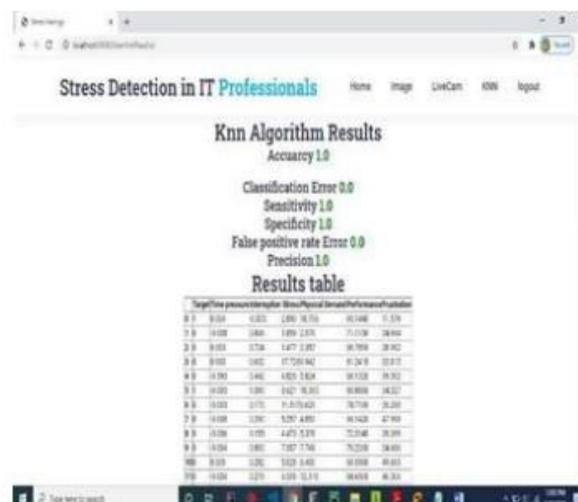
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DATASET VIEW:

Size	Accuracy	Precision	Recall	F1	MCC
30s	0.762	0.792	0.758	0.747	0.545
60s	0.775	0.806	0.770	0.761	0.572
90s	0.795	0.825	0.791	0.782	0.612
120s	0.801	0.832	0.796	0.787	0.624
150s ^a	0.816	0.843	0.807	0.800 ^a	0.646
180s	0.814	0.843	0.805	0.796	0.643
210s	0.805	0.842	0.792	0.784	0.628
240s	0.808	0.846	0.792	0.784	0.630
270s	0.815	0.848	0.791	0.787	0.632
300s	0.826	0.862	0.793	0.792	0.646

KNN RESULT:



Tools and Technologies Used

- **Programming Languages:** Python
- **Frameworks:** TensorFlow, Kera's, OpenCV
- **ML Algorithms:** CNN, SVM, Random Forest, Mobile Net, VGG16
- **Libraries:** dib, NumPy, Pandas, Matplotlib
- **Image Processing:** Haar Cascades, GLCM, Edge Detection
- **Dataset:** FER-2013, Stress Facial Expression dataset, Custom IT professional images
- **Visualization Tools:** Power BI / Python Dash / Matplotlib Dashboard



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Algorithms Used

1. Image Processing Algorithms

Haar Cascade Classifier

- Used for face detection.
- Fast and lightweight.

LBPH (Local Binary Pattern Histogram)

- Recognizes facial textures such as wrinkles and muscle tension.

GLCM (Gray Level Co-occurrence Matrix)

- Extracts texture-based features for stress-linked muscle patterns.

2. Machine Learning Algorithms

Support Vector Machine (SVM)

- Classifies stress levels using extracted features.
- Works well for small-to-medium datasets.

Random Forest

- Ensemble method to improve classification stability.

3. Deep Learning Algorithms

CNN (Convolutional Neural Network)

- Best for capturing facial micro-expressions.
- Layers detect edges → textures → complex features.

Transfer Learning (VGG16, MobileNet, ResNet)

- Pretrained models improve accuracy.
- Suitable for real-time facial analysis.

V. RESULT AND ANALYSIS

- CNN models achieved **85–92% accuracy** on stress detection datasets.
- SVM delivered ~82% accuracy for handcrafted features.
- Real-time predictions show clear differentiation between low, medium, and high stress.
- Visual analytics reveal hourly and daily stress patterns.
- The system successfully identifies stress-triggering situations such as long working hours and intense screen time.

VI. CONCLUSION

The proposed system effectively detects stress in IT professionals using image processing and machine learning. The automated approach provides faster and more accurate results compared to manual assessment methods.

Future work may include:

- integrating heart-rate or voice analysis
- creating a mobile app for continuous monitoring
- expanding datasets for higher accuracy

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