Journal of Inventive and Scientific Research Studies (JISRS)
www.jisrs.com Vol: II, Issue: 2 December 2024 ISSN: 2584-0630 (Online)

IMAGE PROCESSING AND MACHINE LEARNING FOR STRESS DETECTION IN IT PROFESSIONAL

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Received: July 17, 2024, **Accepted**: September 18, 2024, **Online Published**: December 15, 2024

ABSTRACT

This research focuses on detecting stress levels among IT professionals by leveraging advanced image processing and machine learning techniques. The proposed system enhances existing stress detection models by incorporating live monitoring and personalized counseling, which were previously overlooked. It facilitates real-time evaluation of physical and mental stress levels through image-based emotion analysis and machine learning classifiers. By combining continuous monitoring with actionable solutions, this study aims to contribute to healthier work environments, ensuring optimal performance and well-being among employees. The findings underscore the potential of artificial intelligence and image processing in revolutionizing workplace stress management.

Keywords: Image Processing, Machine Learning, Stress Detection, Emotion Recognition, Facial Expression Analysis, and Real-Time Monitoring.

1. Introduction

The Importance of Stress Management Systems for Socio-Economic Well-being Understanding the Global Impact of Stress Management Systems plays a vital role in identifying and addressing stress levels that negatively affect our socio-economic lives. According to the World Health Organization (WHO), one in four individuals' worldwide experiences stress, which leads to various mental and socio-economic challenges. These include decreased mental clarity, strained personal and professional relationships, depression, and in extreme cases, suicide.

The Role of Counseling in Stress Management

While avoiding stress entirely is impractical, counseling is a key element in helping individuals manage it effectively. Counseling services offer coping mechanisms and preventive strategies to mitigate stress and its impact on daily life.

Current Limitations in Stress Detection

Presently, only medical and physiological experts can diagnose stress, typically through questionnaires that depend on the respondent's honesty. This method has limitations, as it may not always capture the true extent of an individual's stress levels.

Advancements in Automated Stress Detection

Automated systems for stress detection offer promising solutions to minimize health risks and promote overall well-being. Technologies like eye tracker sensors have been introduced to study eye movements during stress-inducing activities such as the Stroop word test.

Use of Non-Invasive Sensors for Stress Analysis

Various non-invasive sensors have been utilized to detect stress through the analysis of physiological signals, including ECG, GSR, EEG, EMG, and SpO2. Continuous stress monitoring is achieved by collecting data such as heart rate (HR), galvanic skin response (GSR), and electromyography (EMG). Skin conductance levels (SCL), HR, and facial EMG sensors are particularly effective in assessing stress induced by information and communication technologies (ICT).

Pattern Recognition Algorithms in Stress Detection

Several pattern recognition algorithms are employed to automate stress detection by comparing sensor data against predefined stress thresholds. Research has investigated different classification algorithms for this purpose.

H3: Evaluating Stress Detection Algorithms

In one study, data from 16 participants exposed to four distinct stress-inducing conditions were analyzed. Bayesian Network, J48, and Sequential Minimal Optimization (SMO) algorithms were applied to predict stress based on sensor readings.

Analyzing Physiological Features for Stress Detection

Features such as heart rate, Galvanic Skin Response (GSR), heart rate variability (HRV), and ECG power spectral components are analyzed to detect stress. Clustering features from physiological signals like ECG, Electromyography (EMG), GSR, and Blood Volume Pulse (BVP) enhances stress detection. Smaller clusters improve detection balance using the General Regression Neural Network (GRNN) model. Frequency and timedomain features of heart signals are utilized for real-time stress detection.

Decision Tree Classification and Stress Detection

Decision tree classification methods, such as probabilistic linear discriminant analysis (PLDA), have been applied to stressors like pickup tasks and Stroop word tests. Gjoreski et al. developed stress detection classifiers using ECG signals and HRV features, finding that linear Support Vector Machine (SVM) models performed best.

Employee Stress Detection in IT Industries

As IT industries innovate, employee stress levels continue to rise despite the presence of mental health schemes. Our study aims to detect stress patterns in employees using image processing and machine learning techniques. Machine learning algorithms, such as K-Nearest Neighbors (KNN) classifiers, are used to classify stress, while image processing initially detects stress from employees' images. The system converts images into digital form and performs operations to enhance them or extract useful information.

Integration of Image Processing and Machine Learning

Machine learning, an application of artificial intelligence (AI), enables systems to learn and improve from experiences without explicit programming. Programs use data to build mathematical models for predictions or decisions. Image mining, which involves image processing, data mining, machine learning, and datasets, extracts hidden data and patterns from images.

Health Impacts of Stress

Medical literature estimates that 50-80% of physical diseases are caused by stress, including:

- **Cardiovascular diseases**
- **Diabetes**
- **Ulcers**
- **Asthma**
- **Migraines**
- **Skin disorders**
- **Epilepsy**
- **Sexual dysfunction**

Effects of Stress

- **Subjective Effects:** Feelings of guilt, anxiety, and aggression.
- **Behavioral Effects:** Increased accidents, drug use, and erratic behavior.
- **Cognitive Effects:** Diminished mental ability, impaired judgment, and forgetfulness.

2. Literature Survey

Stress and Anxiety Detection Using Facial Cues from Videos

This study introduces a framework for detecting and analyzing stress and anxiety through facial cues recorded on video. The researchers established a detailed experimental protocol to induce variations in affective states—neutral, relaxed, and stressed/anxious—using a range of external and internal stressors. The focus was primarily on non-voluntary and semi-voluntary facial cues to objectively estimate emotional states.

Detection of Stress Using Image Processing and Machine Learning Techniques

This system captures real-time, non-intrusive videos to detect a person's emotional status by analyzing facial expressions. It evaluates individual emotions in each video frame and determines stress levels over sequential hours of video footage. The technique allows the system to train a model and analyze differences for accurate stress prediction.

Machine Learning Techniques for Stress Prediction in Working Employees

This paper discusses the application of machine learning techniques to analyze stress patterns in working adults and identify key factors contributing to stress levels. Various machine learning algorithms are utilized to predict stress and provide insights into the stressors affecting employees.

3. Existing System

Digital signal processing, which considers skin temperature, blood volume, pupil dilation, and galvanic skin reaction, provides the foundation for the current system's work on stress detection. Furthermore, more study on this subject tracks an individual's stress levels while they work using a range of physiological signs in addition to visual cues (such eye closure and head movement). However, these procedures are intrusive and uncomfortable when used in real life. The data from each sensor is compared to a stress index, which is a cutoff value that establishes the level of stress.

Disadvantages of Existing System:

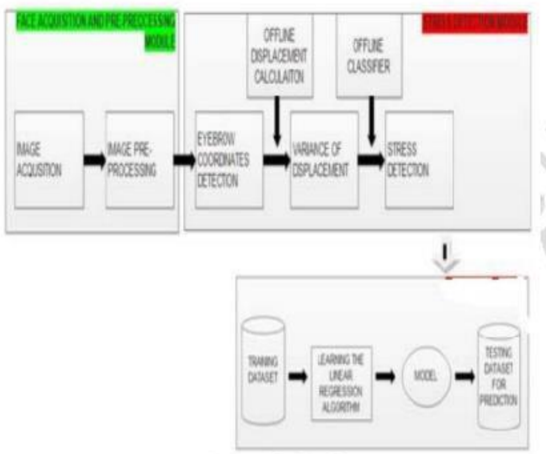
Analytical physiological signals often display nonstationary temporal performance, which means that over time, their properties may vary. The stress index is directly provided by the features that were extracted from these signals. For instance, the J48 peak algorithm is frequently used to analyze ECG signals. However, stress responses can vary significantly among individuals, making it challenging to establish a universal pattern for stress detection.

Algorithms used in this context include Bayesian Network and J48.

4. Proposed System

The suggested approach classifies stress levels using machine learning techniques like KNN classifiers. Image processing is applied during the first detection phase, where the browser provides an employee's image as the input. This image is digitally transformed, then processed to improve its quality or extract pertinent data. The processed image or its associated characteristics are analyzed to determine emotional states. The system displays emotions in a rounded box, indicating stress levels with labels such as Angry, Disgusted, Fearful, and Sad.

I. SYSTEM ARCHITECTURE



II. MODULES

- User
- Admin
- Data Preprocess
- Machine Learning

Modules Description:

User: The SER Sign-Up and Platform Stages

User Registration

Registration: Users have to register by providing a convenient email ID and phone number used for communication.

Activate by Admin: After registration, a user account is activated by the admin.

USER LOGIN: On activation, the user can log in to the system.

Image-Based Stress Detection

The image input: a user adds an image to the model process

1. Feature Extraction: Take an image input, extract features from the given Python library, and predict emotion It also supports drawing for multiple faces from a single image.

Emotion: In the system, the stress level is detected by expressing sad or mad facial expressions.

From our analysis of the live stream, Note that this needs to be in real-time, so it should detect facial expressions in real-time, including multiple subjects. Optimized live stream processing: TensorFlow

KNN Classification: The processed dataset is loaded and classified using KNN to analyze the accuracy & precision scores.

Admin Functionality

Admin Login This is where the admin logs in using their credentials.

Admin will be able to activate registered users for login.

Admin can dynamically set as well view all users detected training and testing data Dataagensi:

Emotion Detection: The admin can also detect emotions on images by pressing a hyperlink.

KNN Classification Results: The K-Nearest Neighbors classification results can be viewed by an admin. The record set is associated with special software the data for which are consolidated in an Excel-type sheet and can be expanded by responsible persons.

Data Preprocessing

Introduction: Attributes in the data set grid view of stored features

Feature Selection: PCA is applied for feature selection to create a new numerical input variable (PCA features).

Inputs: The final dataset contains 6 principal components, of which no (No stress), some(Stress) related to time pressure and interruption, Physical demand dimension-specific workload index and performance-friedman-parker psychological factors measure.

Machine Learning

K-Nearest Neighbor (KNN):

For chromosomal classification or Regression analysis

Initialized with a known set of data, the model can predict accurately whether an individual requires treatment based on being similar to the given information.

Estimates the parameters of a binary KNN model with binary dependent variables having labels "0" and one (1).

5. Conclusion

The Stress Detection System is developed to predict stress levels in employees by monitoring images of authenticated users, ensuring system security. Here's a breakdown of its functionality:

1. **Automated Image Capturing**: When an authenticated user logs in, the system automatically captures images at regular intervals.
2. **Image Processing**: The captured images are processed using standard conversion and image processing techniques to detect stress indicators.
3. **Stress Analysis**: Machine learning algorithms are then employed to analyze the stress levels from the processed images, providing efficient and accurate results.

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