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AN APPROACH FOR HUMAN STRESS DETECTION USING ADAPTIVE BOOSTING ALGORITHM

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Abstract
Stress detection is essential for monitoring mental health and improving one's health. This study presents a machine learning approach utilizing the Adaptive Boosting (AdaBoost) procedure to classify Stress Levels. A static dataset comprising physiological and behavioral parameters is cast off as input, including heart rate, blood pressure, and skin conductance. Adaptive Boosting helps process the dataset to predict stress levels efficiently by iteratively combining weak classifiers to form a strong predictive model. The results demonstrate high accuracy and reliability in classifying stress levels, showcasing the potential of this approach for applications in mental health monitoring and stress management solutions. By leveraging the potential of AdaBoost, this research contributes to the development of intelligent stress detection systems, paving the way for enhanced health monitoring and stress management solutions in clinical and personal settings.

Keywords: Stress Detection, Adaptive Boosting algorithm, Stress Levels.

1. Introduction

Stress is a significant factor affecting mental and physical health, leading to various health issues if left unmanaged. With the increasing prevalence of stress-related disorders, early detection and management of stress have become a critical area of research.
This study focuses on detecting stress levels using Adaptive Boosting system, a robust machine-learning procedure that associates multiple weak classifiers to generate a strong predictive model. These features serve as stress indicators, enabling the system to classify stress levels accurately.
AdaBoost offers advantages in terms of classification accuracy and adaptability to diverse data distributions. By using the strengths of weak classifiers and iteratively improving prediction performance, this approach aims to provide reliable stress level predictions. Outcomes of this study could contribute toward advancements in strength monitoring systems then stress management applications, paving the way for effective, data-driven solutions to combat stress-related challenges.

2. Literature Survey

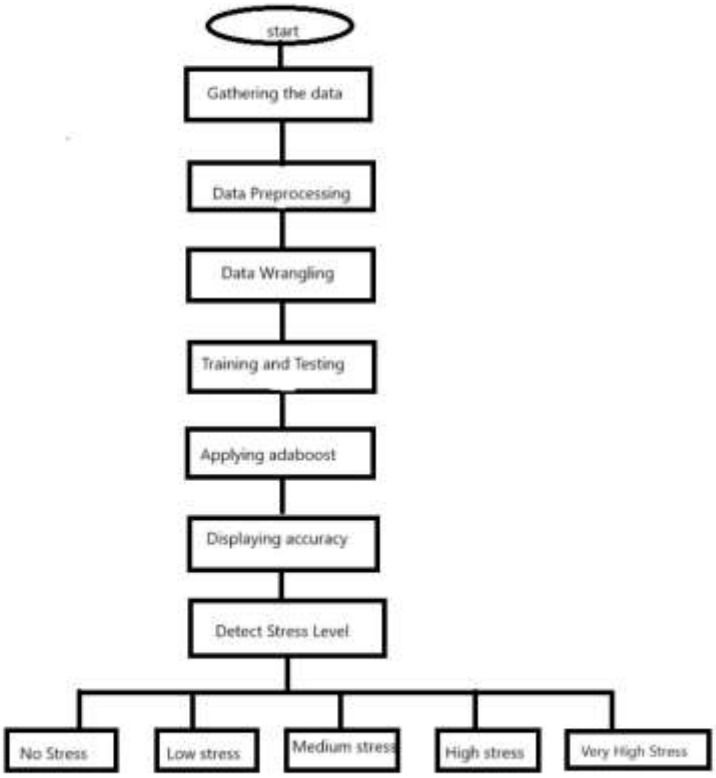
2.1 "**Stress Detection Using Machine Learning**" designed by Sayali Shelke et. al., [1] explores machine learning techniques to identify human stress levels based on physiological parameters and body temperature. The paper discusses various preprocessing methods, feature extraction techniques like discrete wavelet transform, and machine learning classifiers, including SVM, Artificial Neural Networks (ANN) algorithm, and Decision tree algorithm, for improving detection accuracy.
Limitations: The accuracy may not be precise due to techniques used and features of the dataset i.e. stress indicators.

2.2 "**Mental Stress Recognition using K-Nearest Neighbor (KNN) Classifier on EEG Signals**" by Tatiur Rahman et. al., [2], focuses on mental stress detection via electroencephalogram (EEG) data. The study explores the relationship between mental workload and EEG signals, specifically targeting the beta frequency band. Using the KNN algorithm, the study classifies stress states by analyzing the mean power of the beta band. Data were collected from ten participants under various conditions, including resting and task-induced mental workload. Preprocessing steps like artifact removal and feature extraction ensured the reliability of the data.
Limitations: Despite its achievements, the study has limitations concerning accuracy and stress level classification

2.3 “**Stress Detection Based on Naïve Bayes Algorithm**” by Sriyansh et. al., [3] can predict individuals passing stress, which can be a precious tool for society to address the significant issue of stress. By assaying heart rate, Galvanic skin response, and respiratory detector data, the system can determine stress situations and take necessary measures to reduce them. The Naïve Bayes algorithm was used to achieve delicacy, and an algorithm was tested to gain optimal results. Data were divided into training and testing sets and compared against threshold values to determine stress situations and whether the person is stressed.
Limitations: The system cannot properly give a particular stress level; instead, it only determines whether stress is present.
2.4 “**Human stress detection using machine learning**” is a system by Ch. Sai Laxmi and S. Susmitha [4] that detects stress levels by analyzing physiological markers like facial electromyography (EMG). This study incorporates live stress detection and periodic analysis, offering stress management recommendations via surveys. Image processing key role in detecting stress patterns.
Limitations: The accuracy deeply counts on the excellence of physiological and visual information collected from sensors or images.
2.5 “**Detection of Stress for IT Employees using Machine Learning**” by M. Jayabharathi [5] highlights the increasing prevalence of workplace stress in the IT industry due to long hours, tight deadlines, and high-pressure environments. The study proposes using machine learning algorithms to analyze data from digital footprints, surveys, and physiological recordings to classify designs revealing of stress. By monitoring stress levels, machine learning can help improve employee well-being and workplace productivity.
Limitations: The use of machine learning for stress detection faces several challenges, including the reliance on large datasets, which may require access to sensitive employee information.

3. Proposed Model

3.1 System Design



ARCHITECTURE OF STRESS DETECTION USING ADA BOOST

3.2 System Implementation

 Data Gathering: In this phase, data related to human stress is collected. This data could include many physical and behavioral measurements like skin conductance, activity levels, and sleep patterns.
 Data Preprocessing: The gathered information is pre-processed to prepare it for further analysis. It contains tasks like cleaning the data, managing missing values, and converting the data into the right format for the model.
 Data Wrangling: This step focuses on converting the preprocessed information into a more appropriate arrangement for the machine learning algorithm. This might involve feature engineering, normalization, or dimensionality reduction techniques.
 Training and Testing the Dataset: The dataset is trained and tested.
 Applying AdaBoost: The AdaBoost algorithm is applied to the training data. AdaBoost is an collective technique that iteratively joins multiple weak classifiers to create a stronger, more accurate classifier.
 Displaying accuracy: The act of this trained AdaBoost system is tested on the testing set, and the accuracy is displayed.
 Detect Stress Level: Based on the input data, the trained AdaBoost model predicts the stress level of the individual. The possible stress levels could include "No Stress," "Low Stress," "Medium Stress," “High Stress” and "Very High Stress."

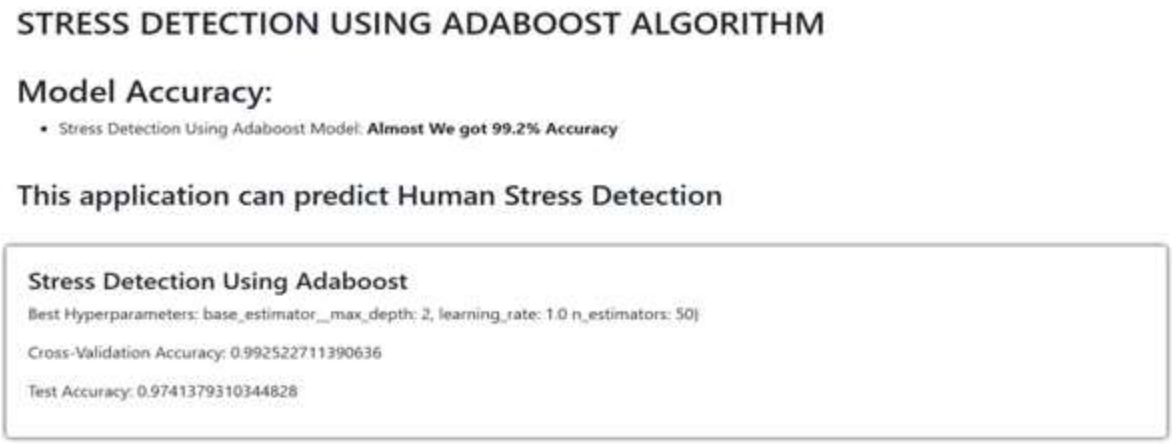
STRESS LEVEL	STRESS TYPE
0	no stress type
1	low-stress type
2	medium stress type
3	high-stress type
4	very high-stress type

Algorithm Details

AdaBoost a machine learning used to ensemble method planned to progress act of weak learners. It combines multiple weak classifiers to create a strong classifier. It is broadly used in classification tasks and is created on the idea of improving the model by focusing on difficult-to-classify instances in each iteration. It operates iteratively and assigns weights to training samples, adjusting them in every step to concentrate more on the trials that previous models misclassified. Hyperparameter tuning and cross-validation are vital steps to optimize the presentation of machine learning representations like AdaBoost.

4. Results

By following the stages mentioned in the architecture we follow the steps and we get our acquired result.



Stress Level	Precision	Recall	F1-score	Support
No Stress (0)	0.96	1.00	0.98	24
Low Stress (1)	1.00	0.96	0.98	28
Medium Stress (2)	1.00	0.95	0.97	20
High Stress (3)	0.92	1.00	0.96	22
Very High Stress (4)	1.00	0.95	0.98	22

Conclusion

In conclusion, AdaBoost offers a reliable and efficient approach to stress detection, especially when combined with careful data preparation and model optimization. Its versatility and performance make it a valuable tool for creating accurate and interpretable stress classification systems. AdaBoost is sensitive to noise and outliers, which can affect its performance in datasets with substantial variability or errors. Proper data preprocessing and feature engineering are crucial to mitigate these challenges. Cross-validation and hyperparameter tuning further confirm that the model simplifies well to unobserved data.

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