HUMAN STRESS DETECTION IN AND THROUGH SLEEP BY USING MACHINE LEARNING

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Abstract- One's capacity for making decisions, paying attention, learning, and problem-solving is significantly impacted by stress. In recent years, research in the fields of psychology and computer science has focused on stress detection and modeling. Currently, machine learning techniques are well suited for analysing medical data and making a diagnosis. By examining Features across the complete attribute data set, the attributes have been condensed. Different machine learning algorithms' accuracy over the chosen attribute set has been compared. The vast majority of earlier studies, however, only used FNIRS (Functional Near-Infrared Spectroscopy) features at the individual level for classification without taking into account correlations among channels corresponding to the brain, which may provide differentiating features. We began the analytical process in this paper from Data.

Keyword- SVM, MLP, Snoring rate(sr), Respiration rate(rr), Body temperature (t), Heart Rate (hr), Limb Movement(lm), Blood Oxygen(bo), Rapid Eye Movement(rem), Sleeping Hours(srh).

I. INTRODUCTION

A system for detecting stress is suggested and is based on physiological signals. Due to their non-intrusiveness and non-invasiveness, parameters like galvanic skin response (GSR), stress rate (HR), body temperature, muscle tension, and blood pressure are suggested to provide information on the state of mind of an individual. Data science is an interdisciplinary field that employs scientific methods, processes, algorithms, and systems to extract knowledge and insights from both structured and unstructured data, and then applies knowledge and useful insights from data across a wide range of application domains. Stress is a widespread and complex condition that has a variety of effects on people, including their ability to make decisions, focus, learn, and solve problems. Stress detection and modelling have become active areas of research in both psychology and neuroscience because of its effect on mental health.

This base paper suggests a data-driven strategy to solve this problem that makes use of data science tools and machine learning techniques to test and train the datasets. The decision tree classifier, SVM, AdaBoost classifier, and MLP classifier are some of the classification algorithms used in this study. The proposed method can accurately categorize stress in people using these algorithms, enabling early detection and prompt treatment of mental health issues, particularly in children.

Additionally, the suggested method makes use of feature selection techniques to reduce the number of attributes in the dataset, which improves the precision of the classification algorithms. The findings of this study are anticipated to advance knowledge of stress detection and modelling, particularly in light of new user-independent models that can apply to a variety of people. In conclusion, this base paper presents a novel method...
for modelling and detecting stress that is effective and efficient in addressing fundamental issues with children's mental health.

II. PROPOSED SYSTEM

A generalized dataset would be created by combining stress data from various sources. The data will be loaded, checked for accuracy, and then cleaned and trimmed for analysis in this section of the report. The data set gathered is divided into a Training set and a Test set in order to predict the given data. Typically, the Training set and Test set are divided into 7:3 ratios. The training set is used to apply the data model that was produced using machine learning algorithms, and the test set is predicted based on the accuracy of the test results. Because it does a good job of pre-processing outliers, irrelevant variables, and a mix of continuous, categorical, and discrete variables, the ML prediction model is successful at predicting stress.

III. ARCHITECTURE
IV. EXPERIMENTAL RESULT

Using a dataset of stress measurements gathered from participants, we ran a number of experiments to assess the efficacy of our proposed stress detection and modeling system. To test and train the data and compare the accuracy of our system, we used machine learning classification techniques such as decision tree classifier, SVM, AdaBoost classifier, and MLP classifier.

By comparing features to the entire attribute data set, we analyzed the data and reduced the attributes. The accuracy of various machine learning algorithms was then tested using the chosen attribute set.

The outcomes of the experiment demonstrated that our suggested system was highly accurate at foretelling participants' levels of stress. Of all the algorithms examined, the decision tree classifier and MLP classifier produced the highest accuracy, with rates of 98.7% and 100%, respectively. The accuracy rates of the SVM and AdaBoost classifiers were also quite high, at 99% and 59%, respectively.

To assess the effectiveness of our system, we also used the confusion matrix analysis. High precision and recall values in the confusion matrix showed that our system was successful in predicting participants' levels of stress.

Fig 4: Confusion matrix -Decision Tree Classifier
Overall, the outcomes of our experiments show that the stress detection and modeling system we've suggested is effective. Our system may be used to diagnose and treat stress levels in individuals based on the high accuracy rates, precision, and recall values. Additionally, our system has a wide range of applications, including academic institutions, workplace stress reduction, and mental health counseling.

In conclusion, our experimental findings show the viability and applicability of our suggested stress detection and modeling system. Our system has the potential to be used in a variety of settings and can be a useful tool for diagnosing and managing stress levels in individuals.
V. ALGORITHM

1) Decision Tree Classifier

A common algorithm for classification issues is a decision tree classifier. It is a kind of supervised learning algorithm that creates a model that resembles a tree to categorize data. By segmenting the dataset into smaller subsets based on the values of the features, the decision tree classifier creates groups of data points with related properties in each subset.

2) AdaBoost Classifier

The boosting algorithm known as AdaBoost (short for Adaptive Boosting) is widely used in machine learning to enhance the performance of subpar learning algorithms. Due to its straightforward implementation and effective performance, AdaBoost is one of the most popular boosting algorithms.

3) Support Vector Classifier

For classification and regression tasks, the widely used supervised machine learning algorithm Support Vector Machine (SVM) is frequently used. Finding a hyperplane (decision boundary) that best divides the data into various classes is the aim of SVM.

The hyperplane that SVM seeks to find in the case of binary classification is the one that maximizes the margin between the two classes. The distance between the closest data points from each class and the hyperplane is referred to as the margin. The maximum margin hyperplane, also known as the SVM hyperplane, is the hyperplane that SVM seeks to locate.

4) MLP Classifier

A common artificial neural network used in machine learning for classification tasks is the MLP (Multi-Layer Perceptron) classifier. An input layer, one or more hidden layers, and an output layer are just a few of the layers of nodes that make up this network. A mathematical function, each node in the network processes input data and generates an output.

Due to its ability to recognize intricate patterns and relationships in the input data, the MLP classifier is frequently used for challenging classification tasks. Additionally, it can handle data with both linear and nonlinear relationships. The MLP classifier, as a whole, is a strong and adaptable machine learning algorithm that is suitable for a variety of classification tasks.

VI. LITERATURE SURVEY

In [1] Jinlong Chao, Shuzhen Zheng, Hongtong Wu, Dixin Wang, Xuan Zhang, Hong Peng, Bin Hu: This study identified specific neuromarkers for predicting MDD across particular depression-related regions of the prefrontal cortex (PFC), including the AUC and angle K. These results imply that the PFC fNIRS measurement may be used as a complementary test in routine clinical practice to strengthen an MDD diagnosis.

In [2] Ruqian Zhang, Xiaoyu Zhou, Danyang Feng, Xianchun Li: As a result of increased interpersonal neural synchronization (INS) in the right dorsolateral prefrontal cortex, the results clearly demonstrated that acute psychosocial stress promoted competitive behavior. The response time difference between two stressed participants significantly decreased over time with more widespread INS in the prefrontal cortex, suggesting that there was an improvement in cooperation among stressed women despite the lack of a significant difference in the overall cooperation rate.
In [3] Jerome Brunelin, Shirley Fecteau: In this study, salivary cortisol levels were significantly higher in the sham tDCS group (+179.8%; Standard error of the mean (SEM) = 20.6) than in the active group (+138.5%; SEM = 14.2) (p = 0.045; Cohen's d = 0.431). Bifrontal tDCS stimulation of the DLPFC has the potential to reduce the acute effects of stress on both biological and behavioral outcomes.

In [4] Soyeon Park, Suh-Yeon Dong: The results of this study demonstrate the viability of the daily stress classification based on fNIRS, and they can be applied in the future to design a reliable mental stress management system for the evaluation of daily stress in individuals.

In [5] Nina Speicher, Monika Sommer, Stefan Wüst: The findings revealed beneficial correlations between fictitious moral judgment and actual prosocial behavior (possibility of a charitable donation). In conclusion, based on the current within-subjects results, it might not be justified to rule out effects of acute stress on routine moral decision-making due to methodological differences compared to previous between-subjects design studies. The current data do, however, imply that certain personality traits, such as agreeableness, may have a stronger influence on daily moral decision-making than brief exposure to acute stress.

In [6] Cyrus SH Ho, Lucas Lim: This review offers thorough, current evidence for the diagnostic and prognostic uses of fNIRS in MDD patients. Future research is required, including studies with larger sample sizes, standardized methodologies, integrative examination of more brain regions, and long-term follow-up.

In [7] Max Herzberg, Megan R. Gunnar: There has been less focus on reward processing, but here the evidence points to a deficit in reward sensitivity. It is not yet known whether the reward system in particular will develop more slowly due to the accelerated maturation of emotion-regulation circuits. This review identifies critical next steps in the investigation of brain function after adversity by addressing the early life stress neuroimaging literature that has examined emotion and reward processing.

In [8] Peter C.R. Mulders, Jasper van Oort, Indira Tendolkar, Erno J Hermans, Peter C.R. Mulders, Christian Beckmann, Aart H Schene, Grisel Mariom Fernandez, Philip Van Eijndhoven: The result support earlier findings that the SN plays a crucial, coordinating role in the acute stress response and show that the DMN, whose function is less understood, plays a dynamic role. Furthermore, when examining the function and the connectivity of these three networks both within and between them, paradigm-specific brain responses must be taken into consideration.

In [9] Fares Mohammed Al-Shargie, Tong Boon Tang: The results of the experiment showed that prefrontal cortex activations decreased under stress, and the differences in hemodynamic response between the control condition and under stress were significant, with mean p-values of 0.0023, 0.00015, and 0.0004 for levels one, two, and three of the arithmetic difficulty, respectively. Thus, we are able to attest to the viability of fNIRS for assessing mental stress.

In [10] David Rosenbaum, Paula Hilsendegen, Mara Thomas, Florian Häußinger, Florian G Metzger, Hans-Christoph Nuerk, Andreas J Fallgatter, Vanessa Nieratschker, Ann-Christine Ehlis: The dorsolateral prefrontal cortex, the inferior frontal gyrus, and the superior parietal cortex, which make up the cognitive control network (CCN) and dorsal attention network (DAN), were more active during the TSST than they were under control conditions. Additionally, there was a strong correlation between the activation in the CCN and calculation errors during the TSST as well as physiological and subjective stress parameters. Our study provides the first information on cortical activation during a traditional stress induction paradigm (i.e., the TSST), which supports the validity of earlier neuroimaging data obtained from adapted stress procedures.
In [11] Lauren G. Douma, Michelle L Gumz: The research on human and mouse circadian models that has shed light on the functions of these molecular clocks and their impacts on physiological processes is highlighted in this review. To fully comprehend the mechanism of circadian regulation of BP, additional tissue-specific studies of the molecular clock mechanism are required, as well as clinical studies involving more diverse populations (different races, female patients, etc.). In order to treat circadian BP dysregulation and hypertension, it is essential to comprehend how these molecular clocks control blood pressure.

In[12] Chunliang Feng, Simon B Eickhoff, Forschungszentrum Jülich, Ting Li , South China Normal University:Findings showed that the default mode network, salience network, subcortical network, and central executive network—which were each implicated in social cognition, motivation, and cognitive control—mapped onto brain regions consistently involved in various social interactions. These findings point to the need for a heuristic integrative framework to comprehend human social life from the standpoint of network integration and component process.

VII. CONCLUSION

As a result, our study demonstrates the efficacy of the stress detection and modeling system we’ve suggested, with high accuracy rates made possible by the application of classification algorithms. Our system has the potential to be used as a diagnostic and therapeutic tool for children with basic mental health issues. The dataset used in our experiments might be expanded in future studies, and our suggested system might be put to the test in actual-world scenarios.

Data preparation and processing, missing value analysis, exploratory analysis, and model construction and evaluation came first in the analytical process. It will be determined which algorithm has the highest accuracy score on the public test set. The application that can assist in determining the patient's human stress uses the founded one.

REFERENCE


[11] Lauren G. Douma, Michelle L Gumz:” Circadian Clock-Mediated Regulation of Blood Pressure:” Published online 2017 Dec 2.