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Human Stress Detection Based On Sleeping Habits Using Machine Learning Algorithms

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Abstract- Stress significantly impacts human health, with disrupted sleep patterns being a key contributor. This study introduces a deep learning-based system using Convolutional Neural Networks (CNN) to detect stress by analyzing various sleep-related parameters, including sleep duration, interruptions, heart rate variability, and body movements. Data is gathered through wearable devices and sleep monitoring applications, providing a real-world basis for analysis. The model incorporates time-series analysis and statistical feature selection techniques to enhance its predictive accuracy. Experimental results show that CNN effectively captures complex sleep behaviors linked to stress, enabling accurate classification of stress levels. This research offers an automated and reliable solution for stress detection, supporting improved mental health through better sleep analysis.

Keywords- Stress detection ,Sleep analysis ,Convolutional Neural Networks (CNN) ,Deep learning ,Wearable devices ,Heart rate variability ,Body movements ,Sleep duration ,Sleep interruptions ,Time-series analysis ,Statistical feature selection .

I. INTRODUCTION

Stress is increasingly recognized as a major health issue in today's fast-paced environment, significantly affecting both mental and physical well-being. Scientific studies have established a strong connection between poor sleep quality and elevated stress levels. Disruptions such as irregular sleep duration, frequent awakenings, and inconsistent sleep cycles contribute heavily to stress. Traditional stress detection methods, which rely on psychological evaluations or physiological tests, often require professional assistance and can be timeconsuming. In contrast, the advancement of deep learning has introduced more efficient, automated alternatives. This research proposes a stress detection system based solely on Convolutional Neural Networks (CNN), which can analyze complex patterns in sleep-related data to predict stress levels accurately.

The system focuses on identifying stress using key physiological and behavioral indicators related to sleep, such as heart rate variability, movement patterns during sleep, and sleep cycle disruptions. Data is collected through wearable devices and sleep tracking applications, providing real-world inputs for model training. The sleep data is processed using time-series analysis and statistical feature extraction techniques to enhance the classification capability of the CNN model.

Experimental results indicate that CNN outperforms traditional machine learning models in recognizing stress-related sleep patterns, offering high accuracy in distinguishing between stressed and non-stressed states. This approach offers a non-invasive, automated, and data-driven solution to mental health monitoring, highlighting the vital role of sleep in effective stress management.

II . LITERATURE SURVEY

fNIRS Evidence for Distinguishing Patients With Major Depression and Healthy Controls

- **Authors:** Jinlong Chao, Shuzhen Zheng
- **Year:** 2021
- **Description:** This study explores the use of functional near-infrared spectroscopy (fNIRS) for distinguishing patients with Major Depressive Disorder (MDD) from healthy individuals. The research highlights how neuroimaging techniques can be employed to detect patterns in brain activity, offering an objective measure for diagnosing depression. The findings suggest that fNIRS can serve as an effective tool for mental health assessments.

Effects of Acute Psychosocial Stress on Interpersonal Cooperation and Competition in Young Women

- **Authors:** Jinlong Chao, Shuzhen Zheng, Hongtong Wu
- **Year:** 2021
- **Description:** This study examines the influence of acute psychosocial stress on cooperation and competition among young women. The research indicates that stress significantly affects social interactions, altering decision-making and interpersonal behaviors. The study's outcomes can be applied to stress management strategies, particularly in workplace and social environments.

Impact of Bifrontal Transcranial Direct Current Stimulation on DecisionMaking and Stress Reactivity

- **Authors:** Jerome Brunelin, Shirley Fecteau
- **Year:** 2020
- **Description:** This study investigates the impact of transcranial direct current stimulation (tDCS) on decision-making and stress reactivity. The research suggests that tDCS can modulate cognitive functions and reduce stress-related responses. The findings indicate that non-invasive brain stimulation methods could serve as potential interventions for stress and decision-making impairments.

Effects of Daily Stress in Mental State Classification

- **Authors:** Soyeon Park, Suh-Yeon Dong
- **Year:** 2020
- **Description:** This study focuses on using machine learning techniques to classify mental states based on daily stress levels. By analyzing behavioral and physiological parameters, the research proposes a classification model that can accurately identify stress-induced mental states. The study contributes to the development of AI-driven mental health monitoring systems.

Effects of Gender and Personality on Everyday Moral Decision-Making After Acute Stress Exposure

- **Authors:** Nina Speicher, Monika Sommer, Stefan Wüst
- **Year:** 2020
- **Description:** This study explores the relationship between gender, personality traits, and moral decision-making under stress. The findings reveal that stress exposure influences ethical choices differently across genders and personality types. This research provides insights into psychological and cognitive changes triggered by stress.

III . PROPOSED SYSTEM

The developed system employs machine learning techniques to examine sleep behaviors for identifying stress. It utilizes various sleep-related factors, including total sleep time, frequency of disturbances, and restlessness, to estimate stress levels. By incorporating advanced algorithms such as Convolutional Neural Networks (CNN) and Linear Regression, the model improves the precision of its predictions. The framework analyzes the gathered sleep data, extracts relevant features, and effectively categorizes stress conditions—eliminating the dependency on costly wearable technologies.

IV. MODULES

Data Collection Module
This module is designed to gather sleep-related data from multiple inputs, including smart devices like fitness trackers and smartwatches, mobile apps, or user-maintained logs. It focuses on acquiring crucial parameters such as sleep duration, efficiency, frequency of awakenings, sleep stages, heart rate, and physical movement patterns.

Data Preprocessing & Feature Extraction Module
Responsible for refining the raw sleep data, this module eliminates inconsistencies, manages missing entries, and ensures overall data quality. It also extracts significant features—such as sleep interruptions and heart rate variations—and transforms the data into a consistent format to enhance the effectiveness of the stress detection models.

Machine Learning Model Training Module
This module utilizes machine learning techniques to learn from sleep data and classify stress levels. It primarily incorporates CNN for identifying complex sleep patterns and Linear Regression for assessing the correlation between sleep behavior and stress. The goal is to build a predictive model capable of categorizing stress into different levels.

Stress Prediction & Analysis Module
This component interprets processed sleep data using the trained models to predict stress levels. It not only calculates a stress score but also provides visual insights, helping users understand how their sleep behavior affects their mental state.
5. User Interface & Feedback Module
This module presents the analysis results through an interactive user interface, either on a web platform or mobile application. It offers personalized recommendations for healthier sleep practices and generates alerts when stress levels exceed normal thresholds.

V . CONCLUSION

The research on stress identification through analysis of sleep behaviors using machine learning illustrates the significant impact of sleep patterns on evaluating stress. Utilizing Convolutional Neural Networks (CNN) and Linear Regression techniques, the system accurately categorizes stress levels based on various sleep metrics. The combination of machine learning algorithms with real-time sleep data monitoring enhances detection precision, offering users meaningful insights into their psychological state. This method promotes early stress intervention by delivering personalized suggestions, ultimately supporting better sleep habits and mental well-being.

VI. RESULT

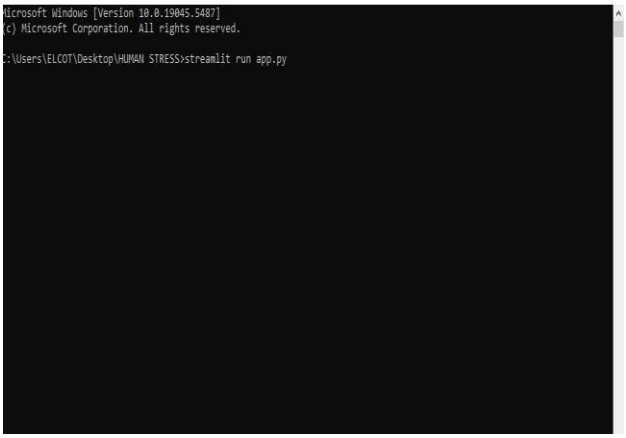

Figure 1: Command prompt

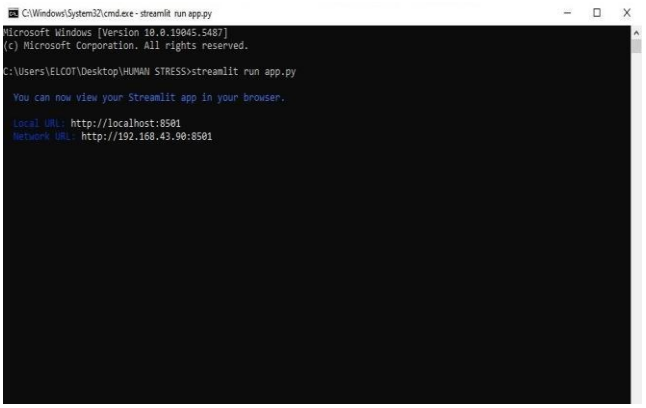

Figure 2: Initializing the Server

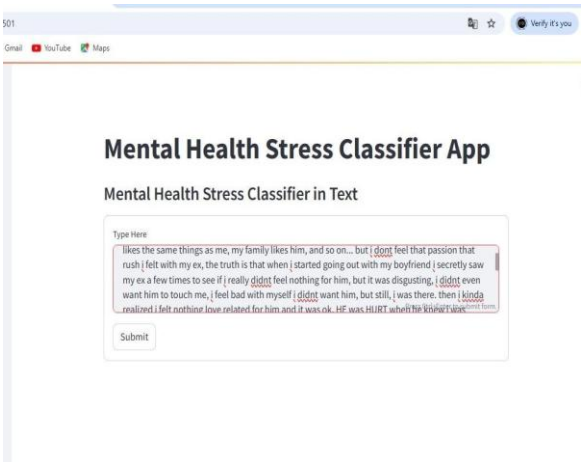

Figure 3: Input the Data

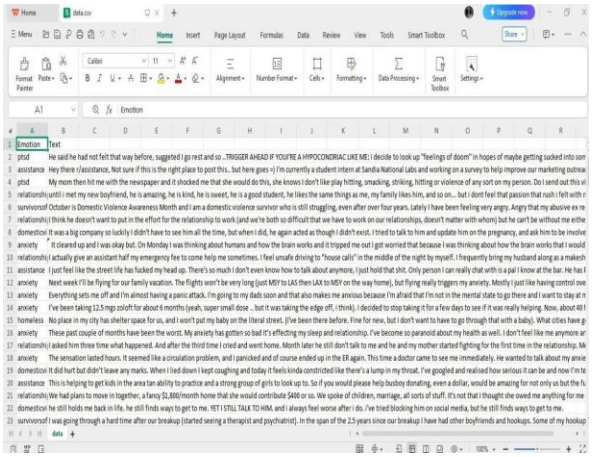

Figure 4: Trained Data

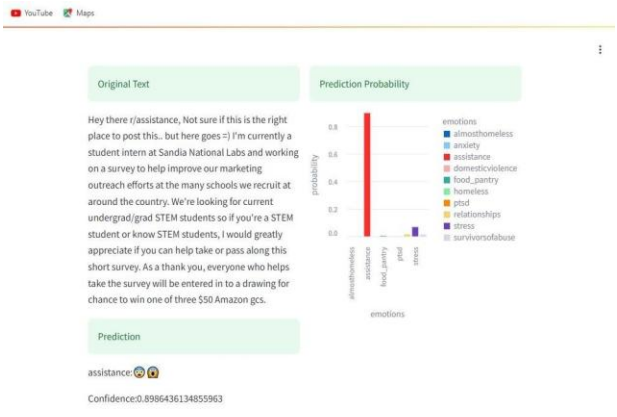

Figure 5: Predict the Stress Level

VII. FUTURE SCOPE

Future advancements may include seamless integration with IoT devices like smartwatches and EEG sensors for real-time stress monitoring. Incorporating deep learning models such as LSTM could enhance the analysis of long-term sleep trends. The system can also offer personalized sleep improvement plans tailored to individual habits. Additionally, combining sleep data with lifestyle factors and deploying a mobile app can ensure comprehensive and accessible stress management.

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