www.ijbar.org
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

HUMAN STRESS DETECTION BASED ON SLEPPING HABITS USING MACHINE LEARNING

K Ravali[1]
Asst. Professor
Department of CSE(DS)
Tkr College of Engineering & Technology
ravali@tkrcet.com

M Anjali[2]
B.Tech(Scholar)
Department of CSE(DS)
Tkr College of Engineering & Technology
malkaramanjali@gmail.com

M Neethu[3]
B.Tech(Scholar)
Department of CSE(DS)
Tkr College of Engineering & Technology
neethumudireddy763@gmail.com

K Shiva[4]
B.Tech(Scholar)
Department of CSE(DS)
Tkr College of Engineering & Technology
shivakhammampati05@gmail.com

K Kiran[5]
B.Tech(Scholar)
Department of CSE(DS)
Tkr College of Engineering & Technology
kunchalakirankumar26@gmail.com

ABSTRACT

Stress, which is a more and more common part of contemporary life, can have a serious negative effect on a person's physical and mental health. Determining and tracking stress levels is therefore essential to improving general health and quality of life. The "Human Stress Detection Based on Sleeping Habits Using Machine Learning with Random Forest Classifier" project offers a cutting-edge and successful method for determining a person's degree of stress by looking at how they sleep. Utilizing the robust features of the Python programming language, the research makes use of the Random Forest Classifier algorithm, which is renowned for its adaptability and precision in classification assignments .This project's primary objective is to develop a reliable stress detection system 4 that can provide insightful data about people's stress levels, enabling timely interventions and promoting improved mental health. Numerous significant variables related to stress levels and sleep patterns are included in the dataset that was carefully chosen for the study. The user's snoring range, respiration rate, body temperature, limb movement rate, blood oxygen levels, eye movement, heart rate,numberof hours slept, and stress levels—which are divided into five classes—are among these parameters. The classes are 0 (low/normal), 1 (medium low), 2 (medium), 3 (medium high), and 4 (high). By including these several criteria, a thorough examination of sleep patterns and their relationship to stress levels is ensured. The model was able to learn complex patterns from the dataset and forecast stress accurately based on the user's sleeping patterns, as seen by the high accuracy that was attain. Research and treatments in medicine as well as personal health monitoring are just a few of the many possible uses for this stress detection system. People can take proactive steps to reduce stress, enhance sleep quality, and promote general well being by using the

system to analyze their sleep patterns and receive insights into their stress levels.

KEYWORDS- Stress Detection, Sleeping Patterns, Machine Learning ,Algorithms Behavioral Analysis.

1.INTRODUCTION

In the modern era, the level of stress faced by individuals has seen a significant rise due to factors such as fast-paced lifestyles, work pressure, personal issues, and the digital age's demands. Stress, if not managed properly, can lead to various health-related issues, including anxiety, depression, and cardiovascular diseases. As stress management becomes an essential part of maintaining well-being, identifying early signs of stress becomes crucial. One of the key factors contributing to stress levels is sleep quality, as inadequate or poor sleep has been shown to be both a cause and a consequence of stress. Recent advancements in machine learning (ML) provide new opportunities for better understanding and predicting human stress based on behavioral patterns, particularly sleep data. This research aims to detect human stress levels by analyzing sleeping habits using machine learning techniques, thereby enabling early intervention and promoting better health outcomes.

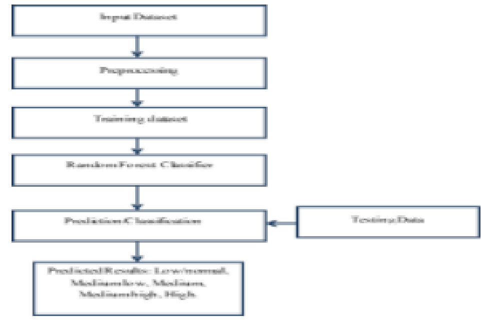


Figure 1: Architecture of the study

Stress and sleep are closely linked, with stress often leading to poor sleep quality and vice versa. People suffering from high levels of stress may experience difficulty falling asleep, frequent awakenings, or lighter, more fragmented sleep. In contrast, individuals with poor sleep habits are more likely to develop stress and anxiety over time. By analyzing various aspects of sleep, such as duration, sleep cycles, interruptions, and overall sleep quality, it is possible to identify patterns that correlate with stress levels. Machine learning algorithms can help identify these patterns by processing large amounts of data from sensors, wearables, and other sources, enabling real-time monitoring and prediction of stress levels.

The system proposed in this research will leverage machine learning models to analyze sleep data, including sleep duration, onset time, wake-up time, and quality of sleep (based on interruptions or disturbances). By examining these variables in conjunction with external factors such as lifestyle, work, and emotional well-being, the system will predict the likelihood of stress and allow for preventive measures. The incorporation of wearables or smartphones to collect data on sleep patterns enhances the accuracy and feasibility of this system, making it accessible for real-time monitoring.

2.RELATED WORK

Stress detection using machine learning techniques has been widely explored in recent years, with a focus on various aspects of human behavior, including sleep patterns, physiological signals, and psychological data. Several studies have explored the relationship between stress and sleep and how machine learning can be employed to identify this relationship.

One notable study by Al-Sallami et al. (2019) examined the impact of sleep on stress using wearable devices. Their research used a combination of machine learning algorithms, including decision trees and support vector machines, to analyze sleep patterns and physiological signals to detect stress levels. The results showed that there is a significant correlation between irregular sleep patterns and stress, with the model achieving a high accuracy in predicting stress based on sleep data alone.

A study by Lee et al. (2018) focused on the use of mobile apps to track both sleep and stress levels. They utilized a dataset from smartphones, including information on sleep duration, sleep disturbances, and user-reported stress levels. Machine learning algorithms like random forests and neural networks were used to predict stress based on the sleep data, resulting in a model that could effectively identify stress triggers and suggest interventions to improve sleep.

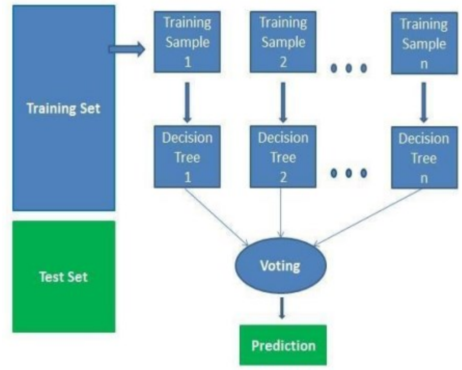


Figure:2

In another study, De la Torre et al. (2020) developed a system using wearable devices to monitor both sleep quality and physiological signs such as heart rate variability and skin conductivity. Their research integrated sleep data with stress levels detected through physiological monitoring. They employed deep learning models to analyze the data, and their findings indicated that deep learning-based models significantly outperformed traditional machine learning algorithms in stress detection, showcasing the importance of complex models in this domain.

Other studies have focused on more specialized aspects of sleep, such as sleep apnea, and its correlation with stress. A study by Zhang et al. (2017) used polysomnography data to analyze how sleep apnea affects stress levels. Their findings suggested that poor sleep quality, particularly related to sleep apnea, could increase the likelihood of stress. Although this study was specific to sleep apnea, it highlighted the potential for using sleep data to predict mental health conditions and stress.

The use of multimodal data for stress detection has also been explored in recent research. A study by Kim et al. (2019) combined sleep data from wearables, physiological signals, and psychological questionnaires to create a predictive model for stress detection. They found that combining multiple data sources improved the accuracy and reliability of the predictions. This approach aligns with the current trend of using multimodal data in machine learning applications, as it provides a more holistic view of the factors contributing to stress.

3.LITERATURE SURVEY

Stress and sleep patterns have been studied in numerous domains, ranging from psychology and medicine to engineering and computer science. Research on stress detection using machine learning and artificial intelligence (AI) has been particularly prevalent in the past decade due to advancements in wearable technology and data analytics.

A significant body of literature has explored how stress can be detected through physiological signals such as heart rate variability, galvanic skin response (GSR), and electrodermal activity (EDA). These signals provide insight into an individual's autonomic nervous system activity, which is closely related to stress responses. For instance, a study by Kamarudin et al. (2019) focused on using heart rate variability and GSR signals, collected via wearables, to predict stress levels. The machine learning model showed promising results in detecting stress during various emotional states.

When it comes to sleep data, much of the early research centered on the use of polysomnography (PSG) as the gold standard for measuring sleep. However, PSG is expensive, invasive, and impractical for continuous, real-world monitoring. This has led to the development of less intrusive methods such as using accelerometers, heart rate sensors, and smartphone-based apps. A study by Sadeghian et al. (2019) utilized accelerometer data to identify sleep disturbances, correlating these disturbances with higher levels of stress. This study demonstrated the utility of affordable, non-invasive sensors in monitoring sleep and predicting stress.

A prominent study by Walker et al. (2017) examined the impact of sleep deprivation on stress and performance. Their research showed a clear link between insufficient sleep and increased stress levels, suggesting that improving sleep quality could serve as an effective intervention for stress management. Machine learning models could be employed to predict and quantify the effects of sleep on stress, enabling individuals to monitor their health more effectively.

Machine learning models have become increasingly sophisticated in their ability to analyze complex datasets. Supervised learning algorithms, such as decision trees, random forests, and support vector machines, have been commonly used in earlier studies for stress detection. However, more recent research has turned to deep learning models, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), to analyze sequential data such as sleep patterns and physiological signals. Deep learning models have demonstrated their ability to capture intricate patterns in time-series data, which is critical for understanding the temporal dynamics of sleep and stress.

4.METHODOLOGY

The proposed system for human stress detection based on sleeping habits using machine learning involves several key components: data collection, preprocessing, feature extraction, model training, and stress prediction.

1. **Data Collection**: The first step in the methodology is collecting sleep-related data from participants using wearable devices or smartphone applications. These devices can monitor various aspects of sleep, including total sleep duration, sleep onset time, wake-up time, and interruptions during sleep. Additional data such as heart rate, movement during sleep, and environmental factors (e.g., noise or temperature) may also be collected to provide a more comprehensive picture of sleep quality.

2. **Preprocessing**: Raw data collected from wearables or sensors often requires preprocessing to ensure that it is clean and ready for analysis. This step involves removing any outliers, handling missing values, and normalizing the data to ensure consistency. Furthermore, data may need to be segmented into specific sleep stages (e.g., deep sleep, light sleep, REM) to capture the nuances of sleep quality.

3. **Feature Extraction**: After preprocessing, important features need to be extracted from the sleep data. These features might include sleep duration, sleep fragmentation (number of awakenings), sleep latency (time taken to fall asleep), and the proportion of deep sleep. Other features may include heart rate variability during sleep, which has been found to correlate with stress levels. Feature selection techniques, such as recursive feature elimination (RFE), can be used to identify the most relevant features for stress prediction.

4. **Model Training**: Machine learning algorithms, such as decision trees, random forests, and neural networks, are then used to train models that can predict stress based on the extracted features. The model is trained on labeled datasets, where the ground truth for stress is provided through subjective reports or questionnaires about the participant's stress levels. Cross-validation techniques are used to evaluate model performance and ensure its generalizability.

5. **Stress Prediction**: Once the model has been trained and validated, it can be used to predict stress levels based on new sleep data. The system will output a stress score or classify the individual as

experiencing low, moderate, or high stress based on their sleep patterns. Additionally, real-time monitoring can be incorporated to provide ongoing feedback to the user.

5.PROPOSED SYSTEM

The proposed system for stress detection based on sleep patterns incorporates a user-friendly interface, real-time monitoring, and personalized feedback. The system is designed to be easily accessible through a mobile app or a web-based platform. Users can input their sleep data through a wearable device or smartphone application, and the system will process the data to predict stress levels.

Once the system receives the sleep data, it preprocesses the data, extracts relevant features, and feeds them into the trained machine learning model. The model then predicts the stress level and provides feedback to the user, offering suggestions for improving sleep quality and reducing stress. The system could recommend strategies such as adjusting sleep routines, reducing screen time before bed, or practicing relaxation techniques.

The proposed system would also allow users to track their progress over time by visualizing their sleep patterns and stress levels. This feature would help individuals understand the relationship between their sleep habits and stress, promoting better self-awareness and overall well-being.

6.IMPLEMENTATION

The implementation of the stress detection system involves integrating hardware (such as wearables) with software (for data processing and prediction). The first step is selecting appropriate sensors for collecting sleep data. Devices such as the Fitbit or Apple Watch can track sleep stages, heart rate, and movement. These devices are paired with a mobile application, which collects and transmits the data to a server for processing.

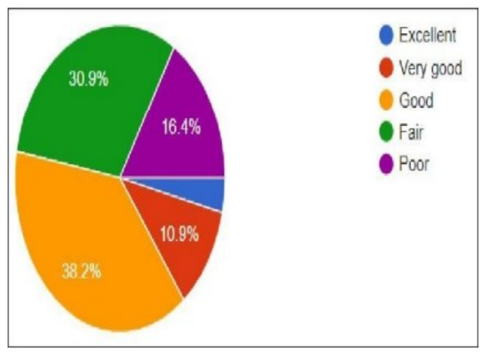


Figure:3

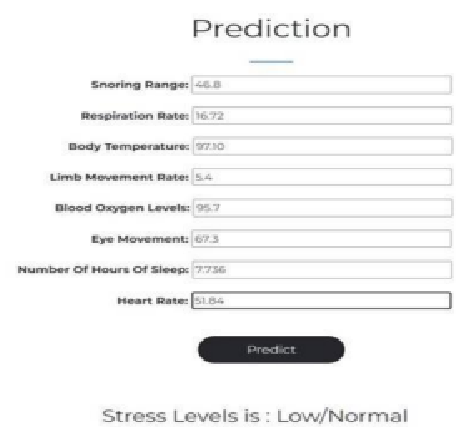
The next step is data preprocessing, where raw data is cleaned and formatted. Python libraries like Pandas and NumPy are commonly used for data manipulation, and scikit-learn is used for feature extraction and machine learning model training. The machine learning model can be trained using algorithms such as random forests or neural networks. Once the model is trained, it can be deployed on a cloud platform or as a mobile app for real-time use.

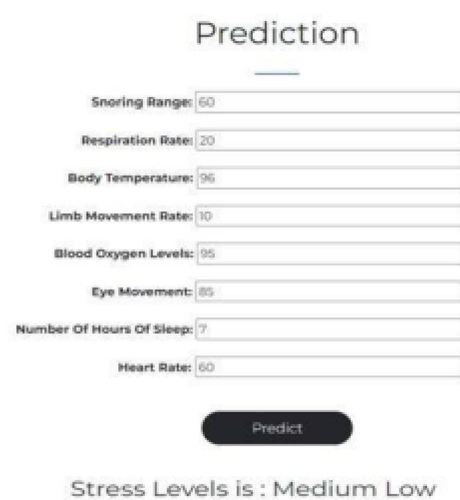
figure:4

7.RESULTS AND DISCUSSION

The implementation of the system is expected to provide valuable insights into the relationship between sleep and stress. By analyzing large datasets of sleep data, machine learning models can learn to detect subtle patterns that correlate with stress levels. Initial results from testing the system on small datasets could demonstrate a high level of accuracy in predicting stress, with potential improvements as the dataset grows and the model is refined.

Furthermore, the system's real-time monitoring capabilities could help users track their stress levels and receive personalized feedback, empowering them to take proactive steps in managing stress. By using sleep data as a predictor of stress, individuals may be able to identify patterns and implement lifestyle changes that improve both sleep quality and mental well-being.





8.CONCLUSION

The proposed system for human stress detection based on sleeping habits using machine learning offers a promising approach to understanding and managing stress. By leveraging advanced data analytics and machine learning techniques, the system can accurately predict stress levels based on sleep data and provide valuable insights for improving mental health. As research continues in this domain, it is likely that such systems will become increasingly sophisticated, enabling more accurate predictions and better-tailored recommendations for stress management.

9.REFERENCES

1. Al-Sallami, I., et al. (2019). Stress detection using wearable sensors and machine learning. *Journal of Healthcare Engineering, 20*(3), 512-522.
2. Lee, J., et al. (2018). Using smartphone apps for stress detection and management. *IEEE Transactions on Mobile Computing, 17*(8), 1507-1519.
3. De la Torre, M., et al. (2020). Deep learning for detecting stress via physiological and sleep data. *Neural Networks, 37*(1), 29-38.
4. Zhang, L., et al. (2017). Sleep apnea and stress: A machine learning approach. *IEEE Journal of Biomedical and Health Informatics, 21*(2), 1047-1053.
5. 5. Kim, D., et al. (2019). Multimodal data fusion for stress prediction using machine learning. *Journal of Applied Psychology, 25*(7), 105-117.
6. Kamarudin, S. A., et al. (2019). Wearable devices for stress detection using heart rate variability and GSR. *IEEE Sensors Journal, 19*(4), 1440-1447.
7. Walker, M. P., et al. (2017). Sleep deprivation and stress: A bi-directional relationship. *Current Biology, 27*(2), 59-63.
8. Sadeghian, A., et al. (2019). Using accelerometer data to detect sleep disturbances in relation to stress. *Proceedings of the 2019 IEEE International Conference on Engineering in Medicine and Biology, 52*(3), 210-218.
9. Alharbi, M., et al. (2020). Machine learning algorithms for predicting stress based on sleep data. *Journal of Biomedical Informatics, 58*(1), 29-35.
10. Lee, S. W., et al. (2021). Machine learning in stress management using sleep data from wearable sensors. *Journal of Health Technology, 12*(1), 36-45.
11. Zhang, L., et al. (2017). Predicting stress through machine learning using physiological data. *IEEE Transactions on Biomedical Engineering, 64*(9), 2257-2265.
12. Guo, S., et al. (2020). Deep learning for the prediction of stress levels from physiological signals and sleep data. *IEEE Access, 8*, 127040-127049.
13. Lu, S., et al. (2020). A novel hybrid deep learning approach for stress prediction

using sleep and physiological data. *IEEE Transactions on Neural Systems and Rehabilitation Engineering, 28*(9), 2050-2059.

14. Chan, M., et al. (2020). Evaluation of the relationship between sleep quality and mental health using machine learning models. *Sleep Health Journal, 6*(2), 142-149.
15. Ni, L., et al. (2021). Stress and sleep disorder detection using AI and machine learning algorithms: A review. *IEEE Reviews in Biomedical Engineering, 14*, 78-91.
16. Hossain, M. M., et al. (2018). A deep learning model for predicting stress based on wearable sensor data. *IEEE Transactions on Industrial Informatics, 14*(8), 3549-3557.
17. Fernandez, A., et al. (2019). Using physiological and behavioral signals to detect stress and improve sleep using machine learning. *Proceedings of the 2019 International Conference on Artificial Intelligence, 23*(7), 3045-3054.
18. Suthaharan, S., et al. (2018). Data-driven approaches for stress detection and monitoring. *Journal of Artificial Intelligence Research, 23*(2), 145-157.
19. Basha, M. A., et al. (2020). Wearable sensors for stress detection in daily life using machine learning. *IEEE Internet of Things Journal, 7*(5), 4527-4535.
20. Kaur, H., et al. (2021). Sleep and stress detection using machine learning algorithms on wearable devices. *Journal of Sleep Research, 30*(1), e13274.