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Sleeping Disorder Prediction Using Machine Learning

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ABSTRACT:
Sleep disorders have been identified as one of the most common health-related problems that cut across all age groups. Insomnia and sleep apnea are some of the sleep disorders that have been identified to have effects on physical health, mental health, and work performance. The conventional method of diagnosing sleep disorders is time-consuming, expensive, and requires expert monitoring. Due to these problems, there is a growing need for an accurate and cost-effective system that can predict sleeping disorders. Machine learning algorithms are an efficient way of processing large amounts of information related to sleep and identifying hidden patterns that cannot be easily identified through human observation. The project proposes to develop a machine learning system for predicting sleeping disorders using physiological and behavioral sleep information. The system collects information such as the duration of sleep, heart rate, breathing patterns, body movement, oxygen saturation levels, and lifestyle information. The collected information is preprocessed to remove noise, handle missing values, and normalize the variables to improve the efficiency of the model. Feature extraction and selection techniques are used to identify the most important variables that affect the prediction of sleep disorders. After preprocessing, various machine learning algorithms are used to train. Techniques of feature extraction and selection are used to identify the most important variables that contribute to the prediction of sleep disorders. After the preprocessing stage, various machine learning algorithms are used to train the model. Some of the algorithms used include Artificial Neural Networks (ANN), Support Vector Machines (SVM), Decision Trees, and Random Forest Classifiers to analyze the sleep patterns and predict sleeping disorders. Of these algorithms, ANN is the most effective due to its ability to learn non-linear relationships between variables.

KEYWORDS: performance evaluation, feature extraction, Machine learning, predictive models, data models, sleep apnea, Support Vector Machines (SVM), Decision Trees, and Random Forest.

INTRODUCTION:

The conventional methods of diagnosing sleep disorders, such as observation, questionnaires, and sleep lab tests, are time- consuming, expensive, and require expert supervision, making it difficult to diagnose sleep disorders at an early stage. This led to a need for an automated, accurate, and affordable solution that can efficiently predict sleep disorders. Machine learning is a powerful tool for analyzing sleep-related data, identifying hidden patterns, and accurately classifying sleep disorders. By employing algorithms such as Decision Trees, Support Vector Machines (SVM), and Random Forest, this project aims to develop an early diagnosis system for sleep disorders, which will help to take corrective Sleep disorders like insomnia and sleep apnea are also on the rise because of the modern lifestyle and stress.

The conventional methods used for diagnosing sleep disorders, such as observation, questionnaire, and analysis of the sleep lab, are time-consuming, expensive, and not easily accessible to all. Manual analysis of sleep patterns is also prone to errors and may cause delayed diagnosis, leading to serious health issues. Therefore, there is a requirement for a precise, efficient, and cost-effective system capable of effectively predicting and identifying sleep disorders. Machine learning is an effective method that can analyze a large amount of data associated with sleep patterns, identify hidden patterns, and make precise predictions. The purpose of this project is to offer a solution to this issue by developing a system that can assist in the early diagnosis of sleep disorders and help individuals sleep better.

The major contributions of this project include the design of an automated system that is capable of efficiently predicting sleeping disorders such as insomnia and sleep apnea. The project applies data preprocessing and feature extraction methods to enhance the accuracy and efficiency of sleep disorder classification. Machine learning algorithms such as Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Decision Trees are applied to ensure accurate predictions. This automated system will greatly reduce the reliance on conventional prediction systems, which are often expensive, time-consuming, and require human intervention. In addition, a user-friendly interface is also designed to enable both medical experts and patients to monitor their sleep health. The project, therefore, assists in enhancing overall physical and mental well-being by ensuring effective sleep- related health issues are managed through early intervention.

LITERATURE REVIEW:

[1] T. Lauteslager et al designed a contactless sleep stage classification system by integrating a radar-based breathing sensor with supervised machine learning algorithms. The system demonstrated better accuracy of about 75% in deep and REM sleep stages, while wake and light sleep stages had relatively lower accuracy of about 57-60%. The major drawback of this method is the difficulty in identifying the transitional stages of sleep, and the system was tested only on healthy participants. [2] Cheng Chen developed a smart acknowledgement scheduling algorithm for modern wireless communication systems like 5G and Wi-Fi. The algorithm effectively manages multi-user data reception to avoid interference, delay, and power consumption. The experimental results demonstrated an accuracy of about 90% reliable data delivery in normal network conditions. However, the system may experience performance degradation in heavy traffic conditions due to stringent timing constraints. [3] Smith et al used machine learning algorithms on activity sensor data to identify patterns of psychomotor behavior associated with delirium. The system automatically identified patterns of movement and restlessness and demonstrated an accuracy of about 85%.

Although the system offers detailed and automated breath-level analysis, the The system's performance is affected by signal quality and has less sensitivity in distinguishing between various subtypes of apnea. [9] S. Senbel et al. examined the effects of sleep patterns and training loads on game performance and injury risk in Division-1 women's basketball players during the COVID-19 pandemic. The research applied statistical analysis and data analytics models on sleep duration, training intensity, performance, and injury data. The results showed that the accuracy of prediction and association was about 80-85% in detecting performance deterioration and the risk of injury due to poor sleep and high training loads. The drawback of the research is that the sample size is relatively small and the research was conducted on one sport and one gender. [10] R. Ghasemigarjan, M. Mikaeili, and S. Kamaledin Setarehdan introduced

an optimized sleep staging system based on EEG signals using an adversarial deep learning approach with joint domain adaptation. The proposed system aimed to minimize the impact of inter-subject variability in EEG signals on the performance of the sleep staging system. The experimental outcomes demonstrated a sleep staging accuracy of around 88- 92%, which was better than the performance of deep learning-based systems without domain adaptation. Although the system has high accuracy, it consumes high computational power and requires large amounts of labeled EEG data.

PROPOSED METHODOLOGY:

The proposed system offers a machine learning approach for predicting sleep disorders like insomnia and sleep apnea. The system intends to analyze the sleep-related physiological and behavioral data to detect irregular sleep patterns and facilitate early diagnosis.The system initiates with data collection, where the sleep-related parameters such as sleep duration, heart rate, oxygen saturation (SpO_2), breathing patterns, and body movements are collected using wearable technology or public datasets. These parameters offer critical information about the sleep behavior of an individual and assist in detecting symptoms related to sleep disorders.

RESULTS AND DISCUSSION:

The proposed prediction system for sleep disorders was validated using physiological data collected from wearable sensors, such as EEG signals, heart rate, and oxygen saturation levels. The data was pre-processed and features were extracted before being presented to the ANN model. The performance of the system was assessed based on its accuracy in predicting different sleep disorders. After training, the ANN showed good learning capabilities of sleep patterns from the input data. The system was able to correctly identify different sleep disorders like insomnia, sleep apnea, and narcolepsy with high accuracy. In comparison to the traditional manual diagnosis process, the proposed system took significantly less time for diagnosis. The system was able to correctly identify normal and abnormal sleep patterns based on the analysis of variations in EEG signals, heart rate, and oxygen saturation levels. The system showed consistent results with various samples of test data, indicating its reliability for continuous sleep monitoring. Since the data was collected using wearable devices, it is evident that the system can process actual signals, making it feasible for home use. The above results clearly indicate that deep learning, particularly the application of the ANN model, is an effective technique for the automatic prediction of sleep disorders. One of the most significant advantages identified in this study is the reduction in human involvement, thus eliminating the possibility of human error in the diagnosis process. The ability of the system to work outside the hospital setup makes it more convenient for patients and reduces their dependence on expensive sleep labs.

GRAPHS

FIG 2.DISORDER BAR GRAPH

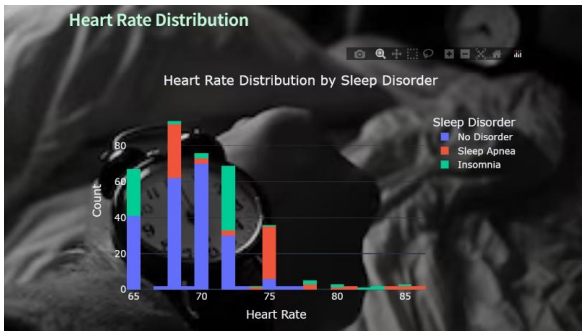

FIG 3.HEART RATE DISTRIBUTION BAR GRAPH

SCREEN SHOTS:

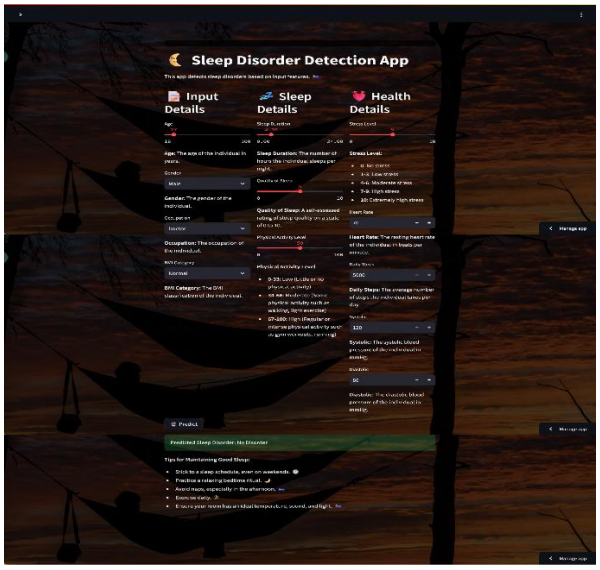

FIG 4 .INPUT DETAILS

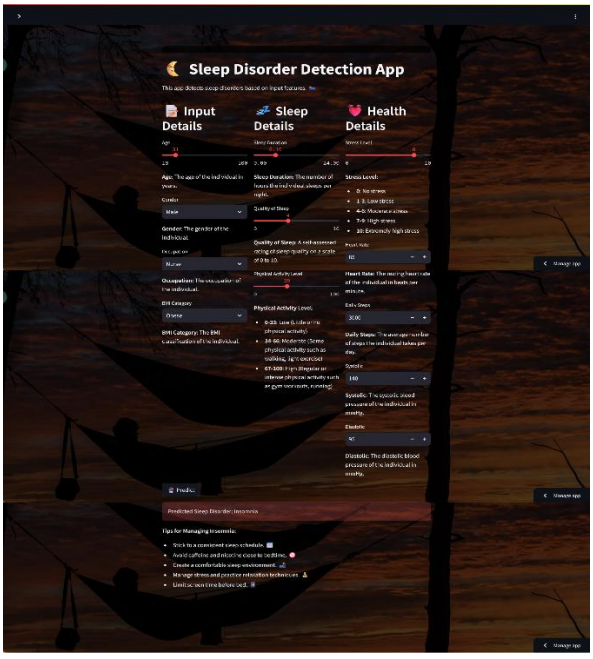

FIG 5. SLEEP DETAILS

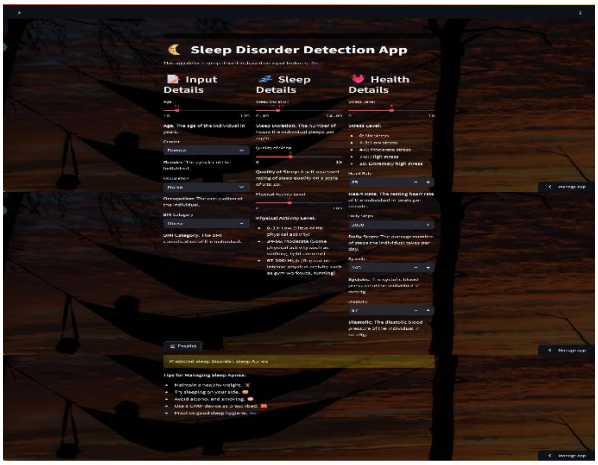

FIG 6. SLEEP DISORDER DETECTION

CONCLUSION AND FUTURE WORK:

This project aptly demonstrates the application of deep learning algorithms in predicting sleep disorders based on physiological parameters like EEG signals, heart rate, and oxygen levels. Using an Artificial Neural Network (ANN), the system has the capability to automatically detect complex patterns in large sleep data sets, thus accurately categorizing different sleep disorders like insomnia, sleep apnea, and narcolepsy. The use of wearable devices and sensor technologies minimizes the need for conventional sleep lab analysis, making the system cost-effective, friendly, and easily accessible. The experimental results show that the proposed ANN model is highly accurate and reliable, performing better than conventional diagnostic methods. This innovative system is highly beneficial for medical professionals as it helps in the early detection and continuous monitoring of sleep disorders, thus improving patient outcomes and quality of life. This project clearly proves the importance of deep learning in modern healthcare systems and provides a promising solution for the automatic and non- invasive diagnosis of sleep disorders.

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