A Prediction of Sleep Cycle Pattern by using Machine Learning Technique Based on Work Related Stressors

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Abstract-Stress has a major effect on sleep cycles; both acute and chronic stress can cause disruptions in the rhythms and level in sleep. Higher stress levels have been shown to predict lower-quality sleep, and there is a reciprocal relationship between the two: disturbed sleep might make one more susceptible to stress. Stress that occurs suddenly is short-term, whereas chronic stress is the future. Continuous work related stress frequently results in more serious health issues, such as immunity vulnerability, heart attack, and psychological disorders. There are various factors such as financial, health, personal and work related stressors that can cause stress and disrupt sleep cycle. A psychological and physiological reaction to perceived threats or challenges often referred to as stressors is what is known as stress. It encompasses a range of mental, emotional, and physiological reactions that occur when someone feels overworked or unable to manage expectations placed on them. In this Paper we are using acute and chronic stress detection using IOT (Internet of Things) device dataset. We are going to apply ML Techniques on the given dataset. ML is basically categorized into two types Supervised and Unsupervised Machine Learning Technique but we are going to detect stress level by using Supervised ML Technique such as Support Vector Machine, Decision Tree, and Naïve Bayes these algorithm defines the accuracy, precision and recall by using Google Colab software. These experiments result with the 95% accuracy, 96% precision and 96% recall of SVM technique is higher in comparison with other techniques.

Keywords- IOT; SVM; Stressors; Decision Tree; Acute; Naive Bayes.

I. INTRODUCTION

Sleep quality refers to how well a person sleeps at night. There are numerous elements that might influence sleep quality, including stress, anxiety, food, exercise, and environmental factors including noise and light levels. Stress is a rapidly developing concern in today's world. It has an impact on an individual's physical and emotional well-being, as well as their ability to function normally. Stress is a psychological, or emotional response to duties or challenges that disrupts one's sense of balance in life. Chronic stress can negatively affect one's health, including immune system degeneration, sleep disturbances, and digestive issues. Stress have a significant impact on sleep, altering sleep patterns, amount and quality. The variable that influence and complicated the process of falling asleep are environmental, emotional, and physiological. [7]. However, there are several stress management techniques available, such as mindfulness meditation, exercise, and therapy, among others; however, sleep is often overlooked [8]. Stress is an important role in general well-being, and knowing its patterns during sleep can help you improve your sleep and manage stress-related health issues [9]. Stress, a typical occurrence in modern life, can negatively impact both physical and mental health [10]. Mental arithmetic, alphabetic tasks, the 'Paced Stroop Test', and other forms of mental stress were frequently utilized in stress simulation. Most research used solely mental workload to elicit mental stress, which is probably a vital stress element in the workplace [11]. Good sleep is vital for general well-being. Poor sleep quality can have a variety of negative effects on one's physical and mental health. Machine learning approaches provide a powerful toolkit for gaining useful insights from complex sleep data and developing prediction models for work load stressors detection [12]. In this paper we are using supervised learning techniques such as support vector machines, random forests, and naïve Bayes which provide sophisticated algorithms to address this pressing need. These algorithms are then used to train models capable of distinguishing between different stressors detection.

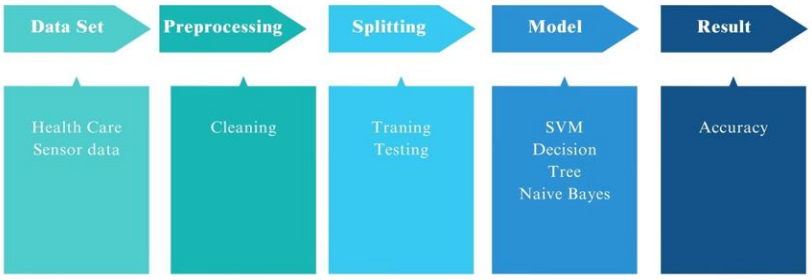
The incorporation of stress detection during sleep has the potential to improve overall health and well-being by revealing hidden stress patterns and allowing for early treatments for better quality of life [13].

This paper includes total VI sections. First section is the introductory section that covers brief description of paper title. Second section describes the literature review. Third section explains various methodology used, in this we used Supervised Ml techniques. Section four is the data collection and we collected the data from kaggle. Section fifth provide the result and last section is based on conclusion.

II. Literature Review

According to recent studies stress detection has become a crucial aspect of human health, as high stress levels can lead to addiction, mental health issues, and other problems. Traditional methods of stress detection, such as self-reporting and physiological measurements, have limitations. Recent studies have explored the use of machine learning algorithms such as random forest, support vector machine, decision tree, logistic regression, naïve byes to detect human stress levels based on behavioral data, including sleep patterns. Studies have demonstrated that ensemble learning algorithms can achieve high accuracy, precision, recall, and F-measure values in stress detection tasks. For example, one study reported an accuracy of 94.25% using an ensemble learning algorithm with an average probability combination method [1]. In this paper focus on stress is a pervasive and complex phenomenon that affects individuals in various ways, leading to physiological and behavioral changes. Early detection of stress is crucial to prevent its adverse effects on mental and physical health. This paper focus on different machine learning algorithms for stress detection such as such as Multilayer Perceptron (MLP), Decision Tree (DT), K-Nearest Neighbor (KNN), Support Vector Machine (SVM), and Deep Learning (DL) algorithms, have been used to classify and detect stress patterns. These algorithms can be trained on datasets collected from various sources, including Internet of Things (IoT) sensors. The decision tree algorithm achieved the best performance, with an accuracy of 95%, precision of 96%, recall of 96%, and F1-score of 96%. These findings contribute to the development of stress detection [2].The study demonstrates the effectiveness of using ensemble learning and feature selection techniques to improve the accuracy and performance of sleep quality prediction models. The results show that the ensemble model achieved an accuracy of 0.9897 and an F1-Score of 0.9745, outperforming the individual models. These findings provide insights into the potential of using wearable devices for sleep quality prediction and demonstrate the effectiveness of combining different models for improved accuracy and performance [4]. The study proposes a novel linear regression-based approach for stress detection using sleep patterns extracted from wearable devices. The approach leverages advancements in machine learning techniques and provides accurate predictions of stress levels based on sleep patterns. These findings contribute to the development of effective stress detection systems that can improve sleep quality and overall well-being Several studies have explored the relationship between sleep patterns and stress levels. These studies have used various machine learning algorithms, including linear regression, decision trees, and support vector machines, to detect stress levels based on sleep parameters such as sleep stages, heart rate variability [7].The study demonstrates the effectiveness of using ensemble learning and feature selection techniques to improve the accuracy and performance of sleep quality prediction models. The results show that the ensemble model achieved an accuracy of 0.9897 and an F1-Score of 0.9745, outperforming the individual models. These findings provide insights into the potential of using wearable devices for sleep quality prediction and demonstrate the effectiveness of combining different models for improved accuracy and performance [8].

III. PROPOSED METHODOLOGY



IV. DATA COLLECTION

In the data collection section we have collected the data from the health sector. These data sets are collected from online platform. The total collected data is 201 and columns are separated into 13 difference values.

V. DATA PREPROCESSING

Pre-processing is an important phase in data analysis that involves cleaning, examining, and modifying raw data to make it acceptable for analysis. This involves resolving missing values, if any, and using data cleaning techniques like normalization or standardization to properly scale the features. To removing the noise data by applying preprocessing techniques.

VI. DATA SPLITTING

In this module, the dataset will be separated into training and testing sets. Divide the dataset into Train and Test. 70% train data, 30% test data. The model will be trained on a subset of data, validated, and tested on unseen data for accuracy. Split the dataset into training and testing. 80% train data, 20% test data.

VII. MODEL

Machine learning algorithms are divided into two parts supervised learning techniques and unsupervised learning techniques in this paper we applied supervised machine learning techniques such as support vector machine, decision tree and naïve bayes are discussed as follows.

1. SUPPORT VECTOR MACHINE

SVMs are excellent machine learning algorithms, especially for classification applications. Using SVMs to examine the association between work stress and sleep habits has a huge potential. SVMs find the optimal hyperplane that maximizes the margin between different classes. These are the most nearby data points to the hyperplane. The purpose of an SVM is to maximize this margin, as a higher margin usually translates to better generalization.

2. DECISION TREE

Decision Tree is also a part of supervised learning techniques. Decision trees, like flowcharts, form a branching structure in which each internal node represents a "test" on an attribute (e.g., workload level), each branch reflects the conclusion of the test, and each leaf node indicates a class label (e.g., "good sleep," "poor sleep").

3. NAÏVE BAYES

Naïve Bayes is also a part of supervised learning algorithm that can calculate the classification problem. This algorithm is classify the text classification and it is very simple to use. It is a probabilistic classifier, which implies that it makes predictions based on an object's probability.

VIII. RESULT

We have performed the experiments on Healthcare IOT sensor based datasets. An open platform Kaggle is used for data collection. Total collected datasets are 200 records of Patient_Ids, Ranging from 0 to 199, total data columns are 13 where Ist column represent the Patient_ID , IInd column represent the Timestamp , IIIrd column represent the Sensor_ID , IVth column represents the Sensor_Type , Vth column represent the Temperature (Â°C) , VIth column represent the Systolic_BP (mmHg) , VIIth column represent the Diastolic_BP (mmHg) , VIIIth column represents the Heart_Rate (bpm) IXth column represents the Device_Battery_Level (%) , Xthcolumn represents the Target_Blood_Pressure ,XIthcolumn represents the Target_Heart_Rate, XIIthcolumn represents the Target_Health_Status, XIIIthcolumn represents the Battery_Level (%). Total datatypes (dtypes) = float64 (6), int64 (4), object (3), memory usage: 20.4 +KB. In these datasets we have applied three machine learning techniques such as SVM, DT&NB for recognizing the sleep pattern using stress level. Using these models we have calculated the Precision, Recall, F_1-score and Accuracy in Table I.

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives + False Positives}}$$

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives + False Negatives}}$$

$$F_1\text{.score} = \frac{2*(\text{Precision}*\text{recall})}{\text{Precision+Recall}}$$

$$\text{Accuracy} = \frac{\text{True Positives+True Negatives}}{\text{True Positives+True Negatives+False Positives+False Negatives}}$$

Table I. Calculate Accuracy of all Algorithm

Techniques	Precision	Recall	F_1-Score	Accuracy
SVM	0.96	0.96	0.96	97
DT	0.44	0.55	0.44	56
NV	0.35	0.45	0.39	46

CONCLUSION

In this paper we have conclude that sleep pattern is recognized using various levels of stress and it is measured using temperature sensor, heart rate ,blood pressure and battery level of wearable device .Stress factors have been calculated by using machine learning algorithms such as support vector machine, decision tree and naïve bayes. After observing the records of each model we have calculated the various factors like precision, recall, f_1-score and accuracy which are depended on stress level .Support Vector Machine is the best model for examine the stress level as compare to other level. SVM gives the 97 % accuracy.

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