HUMAN STRESS LEVEL IDENTIFICATION USING MACHINE LEARNING ALGORITHMS BASED ON SLEEPING PATTERNS

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ABSTRACT:

Stress is a mental or emotional state brought on by demanding or unavoidable circumstances, also referred to as stressors. In order to prevent any unfavorable occurrences in life, it is crucial to understand human stress levels. Sleep disturbances are related to a number of physical, mental, and social problems. This study's main objective is to investigate how human stress might be detected using machine learning algorithms based on sleep-related behaviors. The obtained dataset includes various sleep habits and stress levels. Six machine learning techniques, including Multilayer Perception (MLP), Random Forest, Support Vector Machine (SVM), Decision Trees, Naïve Bayes and Logistic Regression were utilized in the classification level after the data had been preprocessed in order to compare and obtain the most accurate results. Based on the experiment results, it can be concluded that the Decision tree algorithm, when used to classify the data, can do so with 93.27% accuracy, high precision, recall, and f1measure values, as well as the lowest mean absolute error (MAE) and root mean squared error rates (RMSE). We can estimate human stress levels using the study's findings, and we can address pertinent problems as soon as possible.

I.INTRODUCTION:

Stress is one of the major symptoms in our human lives. Stress has a big impact on people's lives. Stress can cause many illnesses, including cardiovascular disease, lung problems, breathing problems, cancer, and other illnesses. The world's population density is increasing people's stress levels. In modern times, stress is a common symptom for everyone. Stress causes serious life-and-death problems for people around the world. When a person suffers from stress, their normal behavior changes and problems arise in their daily life. To do this, the user's behavior must be continuously monitored using machine learning algorithms implemented in the system. This provides real-time data to accurately analyze behavior within the system. In India, 85% of people suffer from stress. In parallel, physiological devices monitor a person's behavior and store it in a database. This data is stored in a database for further analysis by your doctor. Using these values, doctors can easily predict a person's stress level. Therefore, this analysis indicates whether the person is feeling stressed or not Stress means that a person suffering from stress becomes overworked, does not feel comfortable at work, does not sit still, think about something, and is not present. People who are under stress worry that their stress may or may not be cured. In data mining, it is a tool that allows you to explore,

explore, and visualize very large datasets at a high level of abstraction. Classify stress levels using six different data mining techniques including Decision Trees, Naive Bayes, SVM, Random Forests, MLP, and Logistic Regression. These ML algorithms can be used to analyze data and predict whether people will worry the next day. Here you can teach how to recognize stress in humans before, after and during sleep, while assessing people's sleep habits and stress levels. By expanding the number of study attributes, we can now consider even more attributes. Breathing rate, snoring area, rate of limb movement, body temperature, eye movements, blood oxygen levels, sleep duration, heart rate, and stress levels are just some of the factors to consider. Because you can. We propose a project based on a machine learning classification algorithm that predicts the normal behavior of people and people under stress. Stress means that a person suffering from stress becomes overworked, does not feel comfortable at work, does not sit still, think about something, and is not present. The way we interact with people is also different. Stress won't make you happy. If the patient is suffering from stress or depression, a doctor should be consulted for advice on predicting the level of stress and recommending a neurologist or psychiatrist for further analysis and diagnosis. People who are under stress worry that their stress may or may not be cured.

II.LITERATURE SURVEY

1.Stress Assessment and Development of a Primary Care of Psychology Service

Exposure to stressors in daily life and dysregulated stress responses are associated with increased risk for a variety of chronic mental and physical health problems, including anxiety disorders, depression, asthma, heart disease, certain cancers, and autoimmune and neurodegenerative disorders. Despite this fact, stress exposure and responses are rarely assessed in the primary care setting and infrequently targeted for disease prevention or treatment.

2.Machine learning framework for the detection of mental stress at multiple levels

Mental stress has become a social issue and could become a cause of functional disability during routine work. In addition, chronic stress could implicate several psychophysiological disorders. For example, stress increases the likelihood of depression, stroke, heart attack, and cardiac arrest. The latest neuroscience reveals that the human brain is the primary target of mental stress, because the perception of the human brain determines a situation that is threatening and stressful. In this context, an objective measure for identifying the levels of stress while considering the human brain could considerably improve the associated harmful effects. Therefore, in this paper, a machine learning (ML) framework involving electroencephalogram (EEG) signal analysis of stressed participants is proposed. In the experimental setting, stress was induced by adopting a well-known experimental paradigm based on the montreal imaging stress task. The induction of stress was validated by the task performance and subjective feedback. The proposed ML framework involved EEG feature extraction, feature selection (receiver operating characteristic curve, t-test and the Bhattacharya distance), classification (logistic regression, support vector machine and naïve Bayes classifiers) and tenfold cross validation. In conclusion, the proposed EEG-based ML

framework has the potential to quantify stress objectively into multiple levels. The proposed method could help in developing a computer-aided diagnostic tool for stress detection.

3.Role of Machine Learning in Human Stress: A Review

Stress is one type of epidemic of current world. It generates many diseases and is a big source of human suicide. The main aim of this paper is to determine the work of this study conducted on stress using emerging techniques such as machine learning. This study created a comprehensive image for the work of machine learning in stress management. This study completed in some steps including data collection using closest keywords on Web of Science (WoS) database, design network visualization based on previous data, evaluation of selected research article, and finally conclude the all results. We used 4 closest keywords, 5 research articles, 3 publishers, and 4 journals to analyze the work. The results showed that Support Vector Machine (SVM) easily classify the signals. This study mentioned the future direction for the upcoming research in more scientific and significant manner.

4.“**Machine Learning Based Solutions for Real-Time Stress Monitoring**

Stress may be defined as the reaction of the body to regulate itself to changes within the environment through mental, physical, or emotional responses. Recurrent episodes of acute stress can disturb the physical and mental stability of a person. This subsequently can have a negative effect on work performance and in the long term can increase the risk of physiological disorders like hypertension and psychological illness such as anxiety disorder. Psychological stress is a growing concern for the worldwide population across all age groups. A reliable, costefficient, acute stress detection system could enable its users to better monitor and manage their stress to mitigate its long-term negative effects. In this article, we will review and discuss the literature that has used machine learning based approaches for stress detection. We will also review the existing solutions in the literature that have leveraged the concept of edge computing in providing a potential solution in real-time monitoring of stress.

EXISTING SYSTEM:

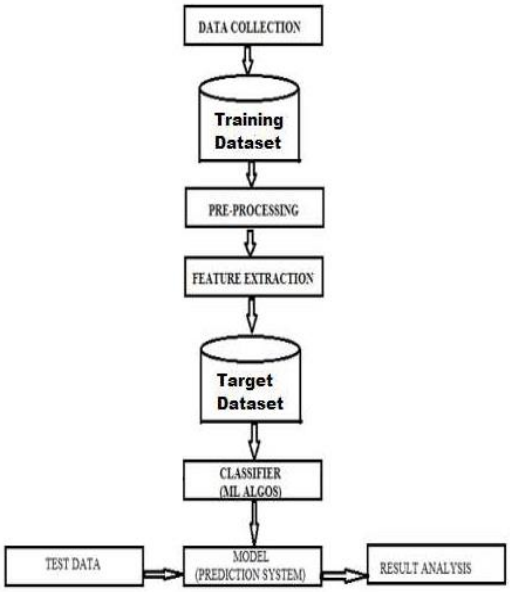
Sa Yo Pillow: Blockchain-Integrated Privacy-Assured Internet of Medical Things (IoMT) Framework for Stress Management Considering Sleeping Habits(2018) Sa Yo Pillow's main objective is to achieve "Smart-Sleeping," which is a comprehensive sleep that satisfies the optimal bodily needs for sleep. Sa yo Pillow suggested a real-time physiological signal which is used to detect sleep quality by taking into account parameters. The parameters are respiratory rate range, the number of hours of sleep, heart rate range, snoring range, eye movement rate, oxygen in blood range, or duration of time spent in Rapid Eye Movement (REM), change in body temperature and limb movement rate.By using six alternative machine learning algorithms such as Random Forest, MLP, Logistic Regression, Decision Tree, Naïve Bayes, and SVM were evaluated using sleeping habits and human stress level. The evaluation was done 10-fold cross validation.The recall, precision, and f-measure computations were then used to compare the evaluation findings. These were utilized to check the suitability of the results. The Naïve Bayes

classifier has the better accuracy when checking with other algorithms. The Naïve Bayes model is the best one for forecasting human stress.

PROPOSED SYSTEM:

The major goal of this study is to detect how human stress change based on sleeping habits. Also the specific objectives are identify the benefits of using a model to detect human stress, identify the relationship between human stress and sleeping habits, identify the major human sleeping behaviors that affect a person's stress, identify the techniques we can use for detecting stress of human and finally, detecting the stress of human based on sleeping habits. We used data mining methods to build a model to determine the level of stress of the people before and after sleep. It is a tool that enables the study, examination, and visualization of extremely large data sets at a high level of abstraction in data mining. Six different data mining techniques, including Decision Trees, Naïve Bayes, SVM, Random Forest, MLP, and Logistic Regression, are utilized to categorize stress levels. Data can be analyzed by these ML algorithms to predict whether or not people would feel worried the next day. Here, we can assess human's sleep habits and degrees of stress while teaching them how to find human stress before, after and during sleep.

ARCHITECTURE DIAGRAM:



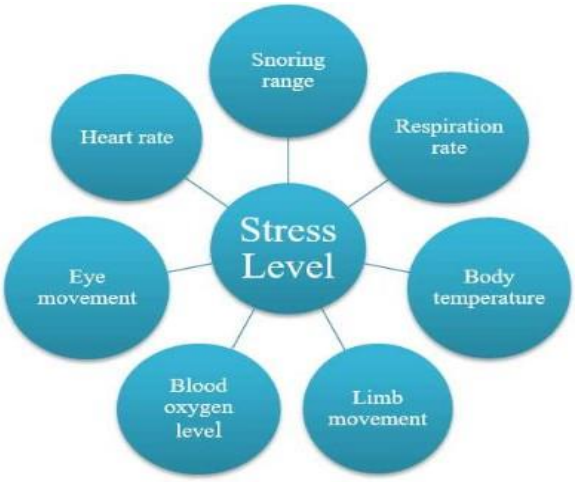
SYSTEM IMPLEMENTATION:

This research mainly focuses to predict human stress based on the behaviors in sleep. The proposed approach includes main three steps. They are data collection, data preprocessing, and classification. Following Fig. 1 explains the architecture of the study.

A. Data Collection

After the study problem has been identified we used secondary data for the research approach. The dataset was obtained from the 'Kaggle' [15] website and was obtained under the seven sleeping habits. The scope of the study was defined as people in society and around 500 people responded to the study. According to the dataset limb movement, snoring range, body temperature, respiration rate, eye movement, blood oxygen level, and heart rate are considered as seven factors. It shows in Fig. These factors aid in

determining the association between a person's sleeping habits and his or her stress level.



B.Training Data

Machine Learning and other artificial intelligence programs require an initial set of data, called training data, to act as a baseline for further application and utilization. This data is the foundation for the program's growing library of information.

C.Data Preprocessing

Pre-processing refers to the transformations applied to our data before feeding it to the algorithm.Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.

In this procedure, incomplete and irrelevant data is identified, and it is then replaced, amended, or eliminated unless it is replaced, altered, or removed. The raw dataset is cleared using the data preparation technique to remove inaccurate, unreliable, and poor data. The data is preprocessed using data cleansing, data transformation, and data reduction. The WEKA software uses a ranking of the attributes to determine which are most impacted by the outcome. According to the ranker among all independent variables, the snoring range has more influence on the dependent variable. Also sleeping hours have the lowest effect on the dependent variable. Finally snoring range, body temperature, respiration rate, heart rate, blood oxygen level, limb movement and eye movement are used as seven independent variables. The stress level is used as a dependent variable. The collected original dataset contained four different stress levels but we combined the first and second stress levels as the low-level stress and the third and fourth stress levels as the high-stress level for our approach. Also, most of the decimal numbers in the dataset are rounded to the nearest decimal point or whole numbers.

D.Feature extraction

The most common approach to data preparation is to study a dataset and review the expectations of a machine learning algorithm, then carefully choose the most appropriate data preparation techniques to transform the raw data to best meet the expectations of the algorithm. This is slow, expensive, and requires a vast amount of expertise. An alternative approach to data preparation is to apply a suite of common and commonly useful data preparation techniques to the raw data in parallel and combine the results of all of the transforms together into a single large dataset from which a model can be fit and evaluated.

E.Target dataset

The target variable of a dataset is the feature of a dataset about which you want to gain a deeper understanding. A supervised machine learning algorithm uses historical data to learn patterns and uncover relationships between other features of your dataset and the target.

F.Classifier

The software is used to classify and assess the preprocessed data. The input data collection is kept in CSV file format. The data collection is divided into training-testing data in 80% and 20% groups. The model was created to target human stress based on sleep behaviors that individuals described as 1- low/normal, 2- medium,3-high The decision tree, Naive Bayes, SVM, Random Forest, logistic regression, and MLP classification algorithms were used to identify the best classification model using the testing data after the training and testing data had been divided.

• Decision tree: A tree structure is used to model the many links between the features and the potential output data in decision trees, which are effective algorithms for classifying data.

• Random Forest: It is a classifier that employs numerous decision trees on different input dataset groups and took averages the outcomes to increase the predicted accuracy of the given dataset.

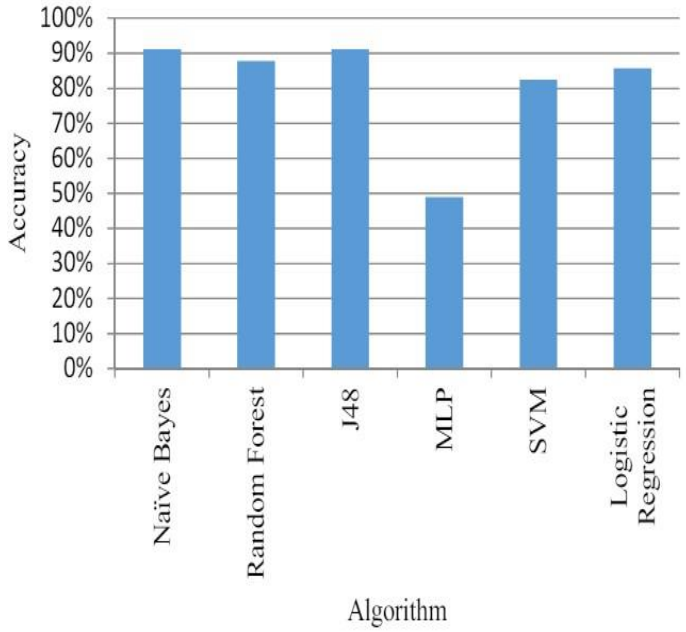
• SVM: Its goal is to determine the best line or decision boundary that can categorize n-dimensional space, enabling us to rapidly grouped new data in the future.

• Naïve Bayes: The value that produces the highest probability after being computed from a conditional probability chain is determined using Naïve Bayes

• Logistic regression: When you need to forecast the existence or absence of a characteristic or outcome based on the values of a group of predictor variables, this might be helpful.

• MLP: The directed graph that joins the output and input layers of an MLP has many tiers of input nodes.

RESULTS ANALYSIS:



In this work, Decision Tree (J48), Nave Bayes, MLP, Random Forest, SVM, and Logistic Regression were used for comparison and evaluation. The accuracy outcomes of these algorithms employing cross validation are shown in Fig. The WEKA software employs cross-validation (by 10) to manage test results and determine the precision of each strategy. The Decision tree classifier has the better accuracy when checking with other algorithms. The decision tree model, which has an accuracy of 93.2%, is the best one for forecasting human stress. The recall, precision, and f-measure computations were then used to compare the evaluation findings. These are utilized to check the suitability of the results. The values for six algorithms are shown in TABLE.

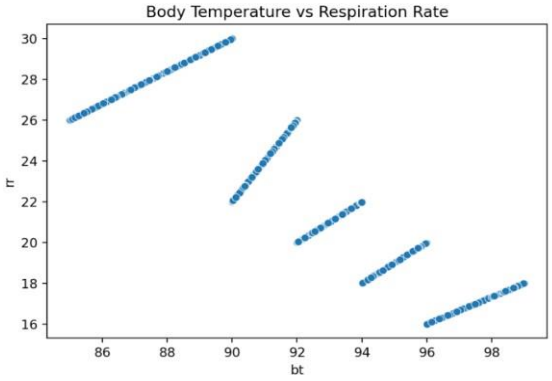
Algorithm	Precision	Recall	F-measure
Naïve Bayes	0.896	0.896	0.896
Random Forest	0.879	0.879	0.879
Decision Tree	0.916	0.916	0.916
MLP	0.501	0.490	0.486
SVM	0.847	0.825	0.82
Logistic Regression	0.857	0.857	0.857

The findings show that when compared to all other classification methods, the Decision tree algorithm has the highest recall, precision, and f-measure values.

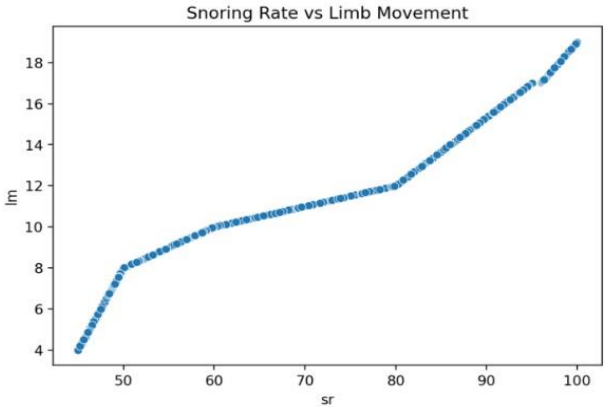
$$Precision = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

$$Recall = \frac{True\ Positive}{True\ Positive + Fasle\ Negative}$$

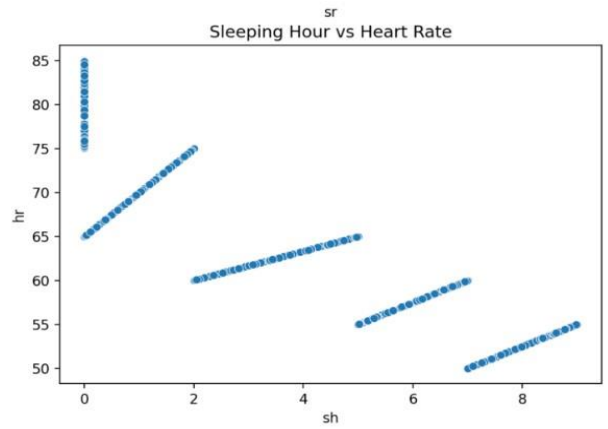
$$F - Measure = 2 * \frac{Precision * Recall}{Precision + Recall}$$



The relationship between respiration rate and body temperature is complex and can vary based on factors such as health status, activity level, and environmental conditions. Generally, when body temperature increases (such as during fever or physical activity), respiration rate tends to increase as well, as the body tries to regulate its temperature by expelling heat through increased breathing. Conversely, when body temperature decreases, respiration rate may decrease as well.



Snoring and limb movement can be related in sleep disorders like sleep apnea. In some cases, increased limb movement can accompany snoring, indicating restless sleep patterns. However, not all snorers have this correlation, as it depends on individual sleep conditions.



The relationship between sleeping rate and heart rate can vary. Generally, during sleep, the heart rate tends to decrease compared to when a person is awake. However, factors like sleep stage, age, overall health, and individual differences can influence this relationship. For example, during REM (rapid eye movement) sleep, heart rate can increase and become more variable.

CONCLUSION;

Human stress is depending on the different criteria and it is important to understand the human stress level to avoid some unnecessary problems. The purpose of this study is to detect how human stress change based on sleeping habits. Also, we identified the benefits of using a model to detect human stress and the connection between human stress and sleep. For this purpose, we collected data including human stress levels and seven habits as the variables through sleep. We used six alternative machine learning algorithms such as Random Forest, MLP, Logistic Regression, Decision Tree, Naïve Bayes, and SVM were evaluated using sleeping habits and human stress level. The evaluation is done 10-fold cross validation. Based on the evaluation results, Decision tree outperforms the other five algorithms, and it is the most effective in forecasting human stress. The best recall, precision, and f-measure values, as well as a lower error rate in MAE and RMSE values, go hand in hand with the Decision tree method's 93.27% accuracy. When discussing the usability and potential applications of this work, we may utilize this model to detect the stress level of the people by adding their sleeping habits to the model, which served as the study's independent variables. Based on the result of stress level, we can deal with that person. In the future, to increase the accuracy of the results, we intend to multiply the data and employ the ensemble learning method, which combines all six algorithms. Because of the less data we could not use the neural networks and deep learning techniques here. Therefore, we intend to apply those algorithms by expanding our dataset, and then it uses to boost the existing accuracy.

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