PREDICTING SLEEP QUALITY IN OSTEOPOROSIS PATIENTS

[1]D.Radhika, [2]Evangeline Angel K, [3]Gopika V, [4]Jeyanandhini K, [5]Kamali P.S
Department of CSE
Vivekanandha College of Engineering for Women,Namakkal,India
[1]radhika@vcew.ac.in, [2]evangelineangel007@gmail.com, [3]gopikavelusamy2001@gmail.com
[4]jeyanandhinikaruppusamy@gmail.com, [5]kamalips2002@gmail.com

***Abstract*—The most prevalent sleep disorder breathing (SDB), has a significant impact on both health and the economy. This study aimed to provide models based on data mining techniques (Sequential minimal Optimization) and select the best model for predicting sleep apnea without polysomnography (PSG) devices, which are the standard method for diagnosing the disease, to pay for patients with this syndrome. Stress is the root cause of the discomfort known as sleep apnea. Experts have been working for a considerable amount of time to identify some of the symptoms of sleep apnea so that they can appropriately classify the condition, as distinct sleep disorders necessitate distinct treatment scenarios. Since a few years ago, the disease known as sleep apnea has targeted India.**

Classification methods use sleep apnea to compare and evaluate their performance. The District Headquarters Hospital (DHQ) served as the source of the dataset. Different classification methods—Naive Bayesian, REP Tree, Random Tree, and PCA with LR—are used to analyze our dataset for proper categorization. With chest and nose respiration data as inputs, we have an accuracy of 96.6% and an accuracy of more than 90% for all signal combinations. It's interesting to note that the PCA WITH LR method also yields these favourable outcomes.

I . INTRODUCTION

1.1 SLEEP APNEADISORDER MINING

After lung cancer, Parkinson's PDSAD Sleep ApneaDisorder is the second most common cause of sleep disorders in women. By 2015, according to statistics, nearly 2.5 lakh new cases could be diagnosed in India. Therefore, prognosis plays a significant role in predicting the course of the PDSAD, even in women who are at a higher risk of succumbing to it but have not yet done so. Oncologists will be able to predict the likelihood of a new case of Sleep Apnea PDSAD if the nature of PDSAD is classified according to the features of the predictor. Despite significant advancements in clinical science and treatment, the grim situation in which an increasing number of people accept the influence of Sleep Apnea PDSAD is undoubtedly troubling. The goal of classification research is to accurately predict the nature of Parkinson's disease. The primary focus of this proposed work is on developing an effective classifier for the PDSAD (PDSAD) data set from the UCI machine learning repository.

An essential component of having the best possible health and operating is having excellent sleep. The quality of sleep can vary greatly depending on a variety of factors, including the time it takes for you to fall asleep and how often you wake up. It has been established that sleep quality declines with age, and it has been well-documented in the media that inadequate sleep and sleep disorders are linked to negative outcomes like weight gain, obesity, diabetes, inflammation, cardiovascular disease, neurocognitive health, mental health, and mortality. Additionally, it has been hypothesised that sleep length and osteoporosis risk are related, with earlier research indicating that middle-aged and senior individuals' bone health may be impacted by inadequate or even excessive sleep [5]. However, prior research has mainly concentrated on brief periods of slumber

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

[5,6,7,8,9,10]. and disruptive sleep apnoea as potential causes of osteoporosis [11,12,13,14,15,16].

1.2 UNSUPERVISED FEATURES

The third category uses large-scale untagged corpora to extract unsupervised features from distributions. When there is a lack of training data or when the distribution of the training and testing data is different, these features are used. The first part of this thesis looks into how to improve a supervised baseline system by extracting supervised and unsupervised features. The paper then suggests two additional tasks to demonstrate the advantages of wider-scope features in active learning (co-testing) and semi-supervised learning (self-training). The well-balanced collections The unsupervised method has the potential to produce results that are comparable to or even superior to those of a supervised multi-label classifier. In addition, we investigate its performance on a standard newswire corpus in addition to the preselected corpus from the standard ACE evaluation. A self-training method for event extraction is presented in Chapter 5. To provide topic-related document clusters, event-centric entity-level Information Retrieval (IR) techniques were incorporated. Experiments demonstrated that bootstrapping performed better on this kind of corpus than it did on a standard corpus. Then, global inference based on the properties of these clusters was used to get better.

1.3 SLEEP QUALITY

Your sleep quality, or whether it is restful and restorative, is what determines how well you are sleeping. It contrasts with sleep satisfaction, which is a more individualised assessment of how you feel about the quality of your sleep. Although sleep quality is not wholly subjective, it is more difficult to assess than sleep quantity. Goals for sleep quality are outlined in guidelines, which also take into account some individual and age variances. To evaluate the quality of one's sleep, four criteria are typically used:

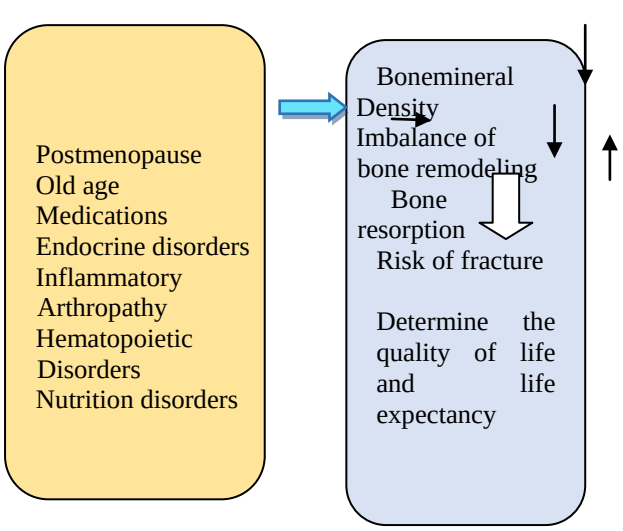
- It is possible to quantify your sleep latency by how long it takes you to drift off to sleep. If you fall asleep within 30 minutes or less of when you go to bed, your sleep may be of high quality.
- This gauges how frequently you awaken during the night. Frequent waking at night might disturb your sleep cycle and diminish your sleep quality. A single awakening or none at all means that your sleep was of high quality.
- The amount of time you stay awake after falling asleep at night is referred to as wakefulness. A good night's sleep is defined as 20 minutes or fewer of nighttime awake.
- Sleep efficiency is the percentage of time spent in bed that is spent sleeping. For maximum health advantages, this measurement needs to be at least 85%.

1.4 PCA WITH LINEAR REGRESSION

By identifying the principal components that capture the most variance in the data, PCA is a dimensionality reduction technique that transforms a high-dimensional dataset into a lower-dimensional space. Data visualization, feature selection, and exploratory data analysis can all benefit from PCA. The supervised learning algorithm known as linear regression, on the other hand, is used to model the relationship that exists between a dependent variable and one or more independent variables. Finding the line of best fit that minimizes the sum of squared errors between the predicted and actual values is the objective of linearregression. Although these methods are distinct, they can be utilized together in certain circumstances. Using PCA as a linear regression preprocessing step is one option. PCA can assist in addressing issues related to multicollinearity, which can occur when the independent variables have high correlations, by reducing the dimensionality of the data.

Linear regression can also be used to model the relationship between the dependent variable and the PCA-identified principal components. When there are a lot of independent variables and it is hard to figure out which ones are most important for predicting the outcome variable, this can be helpful. We can identify the principal components that capture the most variance in the data by using PCA to reduce the dimensionality of the data. We can then use linear regression to model the relationship between these components and the dependent variable.

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15



II. LITERATURE REVIEW

2.1DIETARY FAT REDUCTION AND SLEEP APNEADISORDER OUTCOME RESULTS FROM THE WOMEN'S INTERVENTION NUTRITION STUDY (WINS)

The intelligent outlier detection algorithm (IODA), a method for detecting outliers in time-series data, is developed in this paperwork [1] by Blackburn G L. The "nominal data" and "failure mode" clusters, for example, are examples of clusters that are of interest to this algorithm, which treats a time series as an image. The delay space representation of the time series consists of ordered pairs of consecutive data points taken from the time series, and the algorithm uses density clustering techniques to identify sequences of coincident clusters in both the time domain and delay space. In both the time domain and the delay space, optimal" clusters with mostly nominal or mostly failure-mode data are found. A subset of the optimal time-domain clusters is used to construct a "feature" in the time domain by selecting the best cluster in delay space. Decision trees are used to categorize each datum in the time series as well as segments of the time series. A final quality score or qualityindex for each data point is calculated by combining several individual indicators, depending on the classification of the time series. Analyses of real and simulated time-series data demonstrate the algorithm's effectiveness.

2.2 THE BURDEN OF CANCER ATTRIBUTABLE TO ALCOHOL DRINKING

In this paper, [2]Boffetta P. proposes that an active data mining research issue called "detection of outliers efficiently" has significant applications in fraud detection, network intrusion detection, electronic commerce criminal activity monitoring, and other areas. Finding outliers in appropriate projected subspaces is reasonable and meaningful given the sparsity of high-dimensional data. Outliers in the subspace as projected outliers and anomaly subspace, respectively. The literature on projected outlier detection for high-dimensional data sets with mixed continuous and categorical attributes is sparse, even though numerous effective outlier detection algorithms based on various

2.3 PREDICTING SLEEP APNEADISORDER SURVIVABILITY: A COMPARISON OF THREE DATA MINING METHODS

By scanning the dataset three times, Delen D. demonstrates an upper bound on the amount of memory required to locate all outliers in this work [4]. In practice, it turns out that the upper bound is extremely low. We develop a novel algorithm that combines our theoretical findings with meticulously designed heuristics that make use of the additional memory to improve I/O efficiency because the actual memory capacity of a realistic DBMS is typically larger. By scanning the dataset at most twice, our method reports all outliers and significantly outperforms existing solutions by up to an order of magnitude.

2.4 PESTICIDES AND SLEEP APNEADISORDER

Ferro proposes in this paper [5] that anomaly detection is a significant issue that has been studied in a variety of research fields and application domains. Some techniques for detecting anomalies have been developed specifically for particular application domains, while others are more general. An organized and comprehensive overview of the research on anomaly detection is the goal of this survey. Categorized existing methods following the underlying strategy used by each method. We have identified key assumptions that the methods used to distinguish between normal and abnormal behaviour for each category.

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

These assumptions can be used as guidelines to evaluate a technique's effectiveness in a particular domain when applied to that domain. We first present a fundamental method for detecting anomalies for each category, and then we demonstrate how the various current methods in that category differ from the fundamental method. An easier and more concise understanding of the methods in each category is provided by this template. In addition, we discuss the advantages and disadvantages of each category's techniques. Also, talk about the techniques' computational complexity because it's important in real-world application domains. We hope that the results of this survey will help us gain a better understanding of the various directions in which this topic has been researched, as well as how methods developed in one area can be used in areas where they weren't intended to be used in the first place.

III. SEVERAL TYPICAL PROBLEMS

The worst outcomes for individuals with osteoporosis are hip fractures17. Femoral neck and trochanteric fractures are the two types of hip fractures, and each has a unique etiology18. Since hip fractures are the most serious fragility fractures, we concentrated on measuring bone density in the hip region, particularly in this research.

3.1 SLEEP LENGTH AND QUALITY ARE DESCRIBED

In the NHANES, a simple question is—"How much sleep do you typically get at night on weekdays or workdays? The response groups run from 1 to 12, with 12 denoting less than 12 hours of sleep. The length of sleep was examined as a constant and a discrete variable. Categories were given to a variety of various sleep durations based on prior research20,21,22 ("very short": 1-4 h/day; "short": 5-6 h/day; "average": 7-8 h/day; and "long": > 9 h/day). The following inquiries were used to determine whether someone had a good night's slumber or not: "Ever told doctor had trouble sleeping?" and "Has your doctor ever said you have a sleep disorder?"

3.2 AGE-SPECIFIC FACTORS FOR OSTEOPOROSIS DEFINITION

BMD (g/cm2) was measured using DXA on the research participants. A DXA scan was used to assess the BMD of the femoral neck, trochanteric, intertrochanteric, and total femoral regions. (Hologic, Bedford, MA, USA). On each DXA device, quality control was performed regularly. According to WHO standards, bone mineral density at the femoral neck equivalent to or less than 2.5 standard deviations below the mean for a young individual of the same sex is diagnostic of osteoporosis. We categorise the bone health state into low BMD (osteopenia), osteoporosis, and normal.

IV. HOW THE SLEEP CAUSE OSTEOPOROSIS

For individuals 18 years of age and older, the American National Sleep Foundation recommends 7-9 hours of sleep each day as the ideal amount. Nonetheless, it seems that in contemporary culture, sleep deprivation brought on by lengthy workdays, internet usage, or medical and psychological illnesses is becoming more widespread. The typical night's sleep has been demonstrated to have declined from around 9 hours in 1910 to about 7.5 hours in the present, with many people experiencing sleep deprivation. The regulation of several hormones, including GH, leptin, melatonin, and cortisol, in line with their circadian cycles occurs during nocturnal sleep.

Regardless of whether a person sleeps for a short period or sleeps for a long period, sleep disturbances have been shown to greatly increase the risk of diabetes (5, 6), obesity (7), and cardiovascular disease (1, 8). Researchers are concerned about the effect of sleep quality on health in addition to sleep length.

Lately, several studies have concentrated more on the connection between nocturnal sleep and osteoporosis, an important public health issue with significant morbidity and related medical expenditures (10, 11). Together, it appears that there are some unanswered uncertainties regarding the precise relationship between sleep length and osteoporosis. Many Chinese are accustomed to taking a little nap after lunch, which may help make up for the fact that they get less sleep at night. The notion that taking a nap in the afternoon is healthful and especially beneficial for elderly people who may require more sleep is generally accepted in Chinese culture.

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

V. PREMENOPAUSAL OSTEOPOROSIS

Premenopausal osteoporosis can prevent a person from reaching their optimum bone mass and can cause young adults to have rapid bone loss. Chronic glucocorticoid medication, protracted amenorrhea, anorexia nervosa, rheumatoid arthritis, and conditions that interfere with calcium and vitamin D metabolism may all be linked to premenopausal osteoporosis. Common disorders including dieting, insufficient calcium intake, smoking, and oligomenorrhea can cause milder forms of bone loss. Little practice guidelines exist to direct the management of osteoporosis in young people since prospective trials on screening and therapy in younger age groups are rare. We go over the most crucial clinical issues.we go through the key clinical difficulties surrounding premenopausal osteoporosis, such as measuring bone mass, normal bone accrual, risk factors for early bone thinning, clinical results, and treatment considerations. We place a focus on providing primary care physicians, who frequently encounter premenopausal patients with risk factors for early bone loss, with clinically pertinent information.

While osteoporosis is typically thought of as an illness of postmenopausal women, poor bone mass and rapid bone loss can happen at any age. In this age range, osteoporosis has the most severe effects, and treatment results following a fracture may be subpar. Hip fractures are the most common cause of morbidity and mortality; among white women, the incidence of hip fractures increases ten-fold from 50.1 per 100,000 per year between the ages of 50 and 54 to 530.5 per 100,000 per year between the ages of 70 and 74. 1 During menopause, vertebral fractures and distal forearm (Colles) fractures are more frequent, and they are linked to a greater incidence of hip fractures.

A summary of the key clinical issues in premenopausal osteoporosis to raise raising awareness of high-risk patients, who are frequently seen by primary care doctors first. In this review, premenopausal women's clinical outcomes, normal bone accrual, risk factors for early bone loss, and management concerns are discussed.

5.1WHAT IS POOR QUALITY OF SLEEP

Unsurprisingly, the opposing characteristics of poor sleep quality are present. Your sleep quality is deemed poor if it takes you more than 30 minutes to fall asleep, you wake up many times throughout the night, or it takes you more than 20 minutes to get back asleep after waking up. Even if you receive the necessary amount of sleep, you could feel exhausted the following day. It is significant to remember that these characteristics vary somewhat depending on the individual and age. For instance, as we age, it's typical to wake up more frequently during the night. This won't interfere with your sleep as long as you get back to sleep right away.

VI. EXISTING SYSTEM

- It has only categorized the undesirable effect of altering a PD patient's existing test data groups, potentially undoing the patient's manual history organization efforts.
- It requires a lot of computation; have to perform numerous group similarity computations of attribute test data for each new set of data. Because the current methods for extracting PDPDSAD prediction lack scalability. Getting to the bottom of the scalability issue is crucial. In PD prediction, connections are not uniform.
- Female mosquitoes transmit the life-threatening condition known as sleep apnea. Typically, it is prevalent in hot regions.
- Experts have been trying for a long time to learn about some of the characteristics of Parkinson's PDSAD Sleep Apnea Disorder so that they can correctly classify patients because different patients need different kinds of treatment. Since a few years ago, Parkinson's PDSAD Sleep Apnea Disorder has targeted Pakistan.
- Classification methods use sleep apnea in Parkinson's disease to evaluate and compare their performance. The District Headquarters Hospital (DHQ) AIMS dataset in the UCI Repository served as the source for the collection.

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

VII. PROPOSED SYSTEM

- Good prediction techniques can assist in more accurately predicting Sleep Apnea PDSAD, and methods that can accurately predict sleep apnea PDSAD are greatly needed.
- To improve the Sleep Apnea PDSAD prediction results, this system used two feature selection techniques, forward selection (FS) and backward selection (BS), to eliminate irrelevant features. In the dataset where the data had been identified on full-field digital mammograms collected at the UCI Repository, the findings demonstrate that feature reduction is useful for improving predictive accuracy and that density is irrelevant.
- In addition, the Sleep Apnea PDSAD diagnostic Framework that was proposed is effective in addressing this prediction. The framework proposes a novel method for classifying networks: Apply existing data mining methods to classify based on the extracted prediction, then capture the actors' latent affiliations by extracting disease prediction based on network connectivity.
- In the initial study, disease prediction was extracted using modularity maximization. PD prediction PD data has demonstrated that this framework is superior to other representative relational learning methods.
- Demonstrate that the proposed method guarantees disease prediction sparsity.

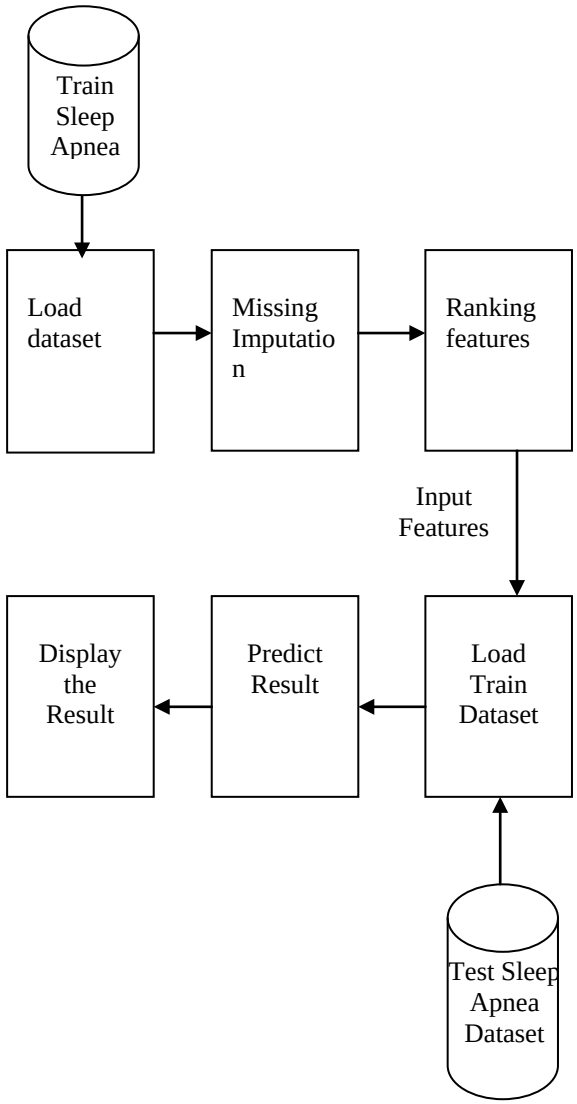


Figure- Explanation of Proposed System

7.1DATA VISUALIZATION AND PRE-PROCESSING

The PDSAD dataset for Parkinson's disease is downloaded and saved as a text file from the UCI Machine Learning Repository website. The values are saved with the associated attributes as column headers after this file is imported into an Excel spreadsheet. The appropriate values take the place of the missing values. The classifier's performance is unaffected by the patient case ID. As a result, it is eliminated, and the outcome attribute is used to define the target or dependent variable, bringing the total number of attributes in the feature set down to 33. The following sections provide a comprehensive overview of the algorithmic methods used for feature relevance analysis and classification.

7.2PCA WITH LRFEATURE SELECTION ALGORITHMS

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

The following is an outline of the general problem of supervised feature selection:

- We want to find a feature subset of size m with the most informative features from a data set called "(xi, yi) ni = 1" where xi is Rd and yi is "1, 2...c." The PDSAD dataset's two effective feature selection algorithms are discussed in detail below.
- Filtering the Mean and STD Score is referred to as the Univariate Mean and STD Score ANOVA ranking. It processes the selection independently of the learning algorithm and is a supervised feature selection algorithm.
- It employs a filtering strategy that prioritizes the input attributes based on their significance. A subset of these attributes can be chosen using a cutting rule. In this area of research, the nature of Sleep Apnea PDSAD—recurrent or non-recurrent—,as well as the predictor attributes, necessitate the definition of the target attribute.
- It selects the top-m features with large scores after calculating the Mean and STD Score for each feature. Another method of feature selection based on logistic regression is the focus of the following subsection.

7.3 IMPROVING CLASSIFICATION ACCURACY AND CRITICAL CONSENSUS MAXIMIZATION:

The following is an outline of the general problem of supervised feature selection:

- We want to find a feature subset of size m with the most informative features from a data set called "(xi, yi) ni = 1" where xi is Rd and yi is "1, 2...c." The PDSAD dataset's two effective feature selection algorithms are discussed in detail below.
- Filtering the Mean and STD Score is referred to as the Univariate Mean and STD Score ANOVA ranking.
- It processes the selection independently of the learning algorithm and is a supervised feature selection algorithm.
- It employs a filtering strategy that prioritizes the input attributes based on their significance. A subset of these attributes can be chosen using a cutting rule.
- In this area of research, the nature of Sleep Apnea PDSAD—recurrent or non-recurrent—,as well as the predictor attributes, necessitate the definition of the target attribute.
- It selects the top-m features with large scores after calculating the Mean and STD Score for each feature.
- Another method of feature selection based on logistic regression is the focus of the following subsection.

7.4 FEATURE REDUCTION BY PCA WITH LINEAR REGRESSION

A mapping from a space with multiple dimensions to a space with fewer dimensions is used in feature reduction. Construction of features, reduction of space dimensionality, sparse representations, and selection of features are all aspects of feature extraction that are frequently used as preprocessing for prediction tasks in machine learning and statistics, such as pattern recognition. Even though researchers have dealt with such issues for a long time, feature extraction has recently received renewed interest. Reduced features in the feature space truly aid in classification, reducing preprocessing costs and minimizing the "peaking phenomenon" in classification.

VII. CALCULATION OF OSTEOPOROSIS

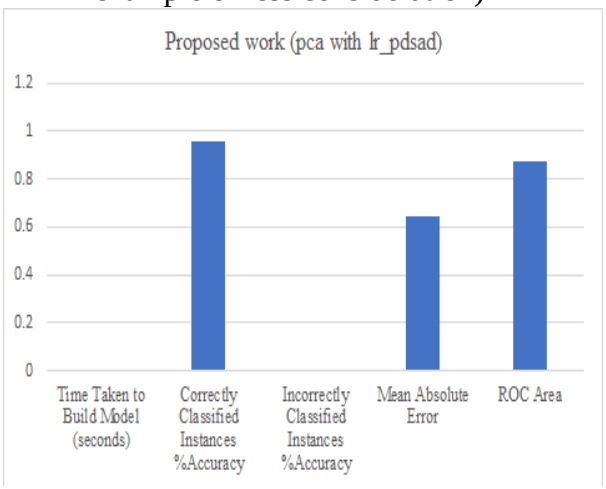
Examiner's Tool (OST). These instruments appear to function similarly and have a fair degree of accuracy in predicting osteoporosis. Another often-used instrument is the FRAX tool (University of Sheffield), which evaluates a person's 10-year risk of fracture. Although the FRAX tool asks questions on prior DXA findings, it is not necessary for it to evaluate fracture risk. One strategy is to perform bone measurement testing in postmenopausal women younger than 65 years old who have a 10-year FRAX risk of major osteoporotic fracture (MOF) (without DXA) greater than that of a 65-year-old white woman without major risk factors because the benefits of treatment are greater in people at higher risk of fracture.

XI. RESULT ANALYSIS

The following are the outcomes of using the CR Rotation test to predict diabetes using structural analysis:

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15

- The behavior of patients with only apnea is collected by the algorithm using a Poisson distribution, or the number of times the Apnea group went to the doctor in the same time frame (e.g., within seven days).
- The patient who has received more care and the patient who has received less care have a log-normal distribution of their testing patterns, or the number of doctor visits are not symmetric around the mean but much to the right (e.g., example of less consideration)



The fundamental motivations behind a chief part examination are the investigation of information to recognize examples and tracking down examples to diminish the components of the dataset with negligible loss of data.

Algorithm	Time Taken to Build Model (seconds)	Correctly Classified Instances %Accuracy	Incorrectly Classified Instances %Accuracy	Mean Absolute Error	ROC Area
Proposed work (pca with lr_pdsad)	0	96%	4% (0)	0.645	0.88

The goal of nugget removal is to break down the variables of interest into smaller components. Nugget Removal reorganizes all of the variables' variance into a new set of components proportional to the number of variables. One of the classification methods is proposed work. This algorithm was used to divide the data based on the dataset in this project. Using this algorithm, we analyzed the classifier output using a variety of statistics and 10 cross validations to predict each dataset instance. After running these algorithms, the classification accuracy is 100 percent, the error rates are zero, the model building time is zero seconds, and the ROC area is 0.875.

On the basis of time, accuracy, error, and ROC, Table 5 displays the PCA with LR Algorithm Accuracy score.

CONCLUSION

The research test different algorithms. The accuracy of the algorithms used in the training was the primary focus of the research. The Sleep Apnea data set was necessary. The test results demonstrate that the PCA WITH LR algorithm is superior. The best approach was when the sample for missing value in SMO training was removed from the study. However, when the sample was kept for missing values, the Random Tree result maintained better accuracy.

The study conducted an experiment in which various data mining algorithms were used to predict the PD and to compare which method was the most accurate. When using various classification algorithms in data mining, the study's predictions do not differ significantly. The experiment may be an important tool for doctors to use when predicting risky cases and providing advice. In terms of predicting PD diseases, the classification model will be able to answer more complex questions. The PCA WITH LR algorithm's predictive accuracy suggests that the parameters used are trustworthy indicators for predicting the presence of PD diseases.

REFERENCES

[1] "Dietary fat reduction and Sleep ApneaPDSAD outcome:" Blackburn, G. L., and Kwan, K. A. results of the Women's Intervention Nutrition Study (WINS),” in IEEE International Journal of Computer Science and Engineering, vol. 32, pp.512.

[2] P. Boffetta and M. Hashibe The burden of alcohol-related cancers," IEEE Journal of Cancer Research and Treatment, vol. 90, pages 119.

[3] Boris Pasche, (2010) Genetics of Cancer" (Research and Treatment for Cancer). Berlin: Springer. pp. 19–20.

[4]"Sleep ApneaPDSAD and breastfeeding," "Sleep ApneaPDSAD and breastfeeding," IEEE International Journal for Cancer Research and Treatment, vol. 15, 2002.

[5] Delen, D., and G. Walker, "Predicting Sleep ApneaPDSAD survivability: a comparison of three methods for data mining," volume of Artificial Intelligence in Medicine 34, pp. 113-127.

[6] H. A. Beydoun et al., "Sex and age differences in the associations between sleep behaviors and all-cause mortality in older adults: results from the National Health and Nutrition Examination Surveys," Sleep medicine, vol. 36, pp. 141–151, 2017.

[7]D. Raman et al., "Polysomnographic heart rate variability indices and atrial ectopy associated with incident atrial fibrillation risk in older community-dwelling men," JACC: Clinical Electrophysiology, vol. 3, no. 5, pp. 451–460, 2017.

[8] G.-Q. Zhang et al., "The National Sleep Research Resource: towards a sleep data commons," Journal of the American Medical Informatics Association, vol. 25, no. 10, pp. 1351–1358, 2018.

[9] A. N. Vest et al., "An open source benchmarked toolbox for cardiovascular waveform and interval analysis," Physiological measurement, vol. 39, no. 10, p. 105004, 2018.

[10] R. Sadeghi, T. Banerjee, J. C. Hughes, and L. W. Lawhorne, "Sleep quality prediction in caregivers using physiological signals," Computers in Biology and Medicine, vol. 110, pp. 276-288, 2019.

[11] Sadeghi, Reza, Tanvi Banerjee, and John Hughes. "Predicting sleep quality in osteoporosis patients using electronic health records and heart rate variability." 2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC). IEEE, 2020.

[12] Sadeghi, R., Banerjee, T., & Hughes, J. (2020, July). Predicting sleep quality in osteoporosis patients using electronic health records and heart rate variability. In 2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) (pp. 5571-5574). IEEE.

[13] Sadeghi, Reza, Tanvi Banerjee, and John Hughes. "Predicting sleep quality in osteoporosis patients using electronic health records and heart rate variability." In 2020 42nd Annual International Conference of the IEEE Engineering in Medicine &Biology Society (EMBC), pp. 5571-5574. IEEE, 2020.

[14] X. Zhang et al., "Sleep stage classification based on multi-level feature learning and recurrent neural networks via wearable device", Computers in biology and medicine, vol. 103, pp. 71-81, 2018

[15] D. Raman et al., "Polysomnographic heart rate variability indices and atrial ectopy associated with incident atrial fibrillation risk in older community-dwelling men", JACC: Clinical Electrophysiology, vol. 3, no. 5, pp. 451-460, 2017

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-10, ISSUE-4, 2023
DOI: 10.21276/ijcesr.2023.10.4.15